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AN INVESTIGATION OF THE FISH POPULATION WITHIN THE INLAND WATERS OF HORN ISLAND, MISSISSIPPI,

a barrier island in the northern Gulf of Mexico*

by

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* A modification of a thesis submitted to the Graduate school of the University of Mississippi in partial fulfillment of the requirements for the degree of Master of Science.

ABSTRACT

An investigation to ascertain the species composition and the relative abundance of the fish population within the inland waters of Horn Island, Mississippi, a member of the offshore barrier island chain, was made from August 1965 to September 1966, and 69 species representing 58 genera and 35 families were encountered. In respect to the fishes certain biological and physical factors were noted.

Forty-nine collecting stations were established on the island, and these were categorized according to the nature of their appearance and location. A salinity range from fresh to 29.9 ppt. was recorded for the sampled bodies of water, with the high salinity areas being under the influence of Mississippi Sound waters. Fishes with both marine and brackish water affinities were collected. Euryhaline species were taken from both fresh water and water which was approaching fresh; however, no true fresh water fishes were obtained.

Members of the Atherinidae, Cyprinodontidae, and Poeciliidae (*Menidia beryllina, Cyprinodon variegatus, Fundulus similis, Gambusia affinnis, and Poecilia latipinna*) contributed most conspicuously to the fish population. Other families which were encountered formed somewhat less conspicuous elements in the population. The killifishes and poeciliids are capable of completing their life histories in the majority of examined areas, and these species contributed most obviously to the permanent occupancy of the inland waters due to their established resident breeding populations.

INTRODUCTION

The coast of Mississippi and part of the Alabama coast are partially separated from the Gulf of Mexico by a chain of barrier islands named Dauphin, Petit Bois, Horn, Ship, and Cat (Figure 1). The body of water, Mississippi Sound, lying between the mainland and the insular group extends some eighty miles from Mobile Bay, Alabama to Grand Isle, Louisiana and is ten miles across at the widest point. The average depth of the Sound is about seven feet at mean low tide. Moore (1961) presents a descriptive account of the Mississippi Sound area.

Most of Mississippi Sound is within the "Fertile Fisheries Cres-

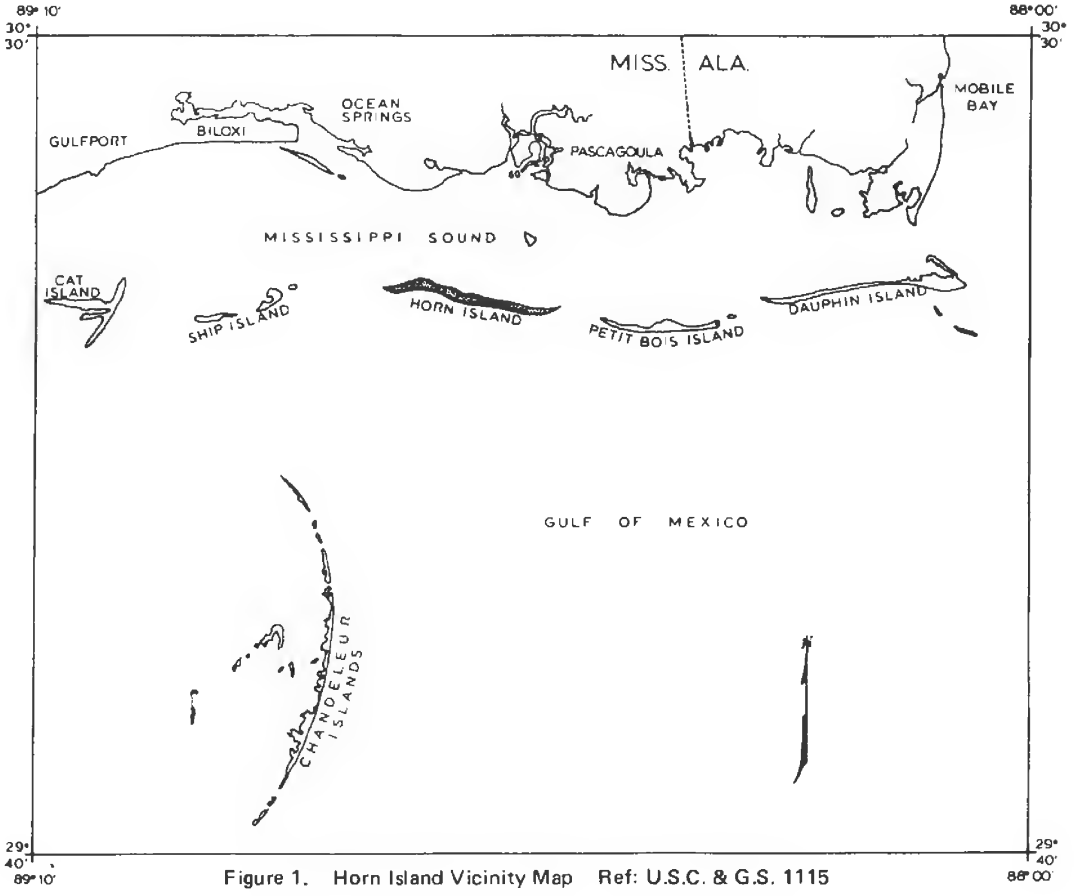

Figure 1. Horn Island Vicinity Map Ref: U.S.C. & G.S. 1115

cent'' (Gunter 1963) and is supplied with fresh water which flows from three major rivers, the Pearl on the west and the Pascagoula and Alabama on the east. Fresh water via several drainage systems also enters the Sound through Biloxi Bay and Bay St. Louis. The brackish nature of the Sound is caused by high salinity water from the Gulf flowing through the island passes and mixing with the drainage of the rivers. The salinity may fluctuate in accordance with periods of heavy, little, or no rainfall. The climate is rather humid and warm in nature with the exception of occasional winters during which sub-freezing temperatures are often experienced.

The present study is concerned with one of the barrier islands, Horn Island, and the fishes which inhabit the ecologically distinct habitat there. The study was conceived following a discussion with Dr. E. Avery Richmond who, after being stationed with the U. S. Army in 1944 and 1945 on Horn Island, prepared a list of the fauna and flora of the island, as well as presenting some interesting historical accounts. In Richmond's (1962) faunal list the fishes given are those species commonly found in waters surrounding the island. Numerous contributions dealing with the flora and certain groups of animals on the island have been made; however, work concerning the fishes, with the exception of Fowler (1931) and Mr. J. Y. Christmas (personal communication), is lacking. A permit allowing the writer to work on the island was obtained from the Department of the Interior - Gulf Island National Wildlife Refuges, Biloxi, Mississippi. A total of 41 collecting trips was made to the island: 16 visits from August 1965 to January 1966 and 25 visits from June 1966 to September 1966.

The primary objectives of the investigation were to ascertain what species compose the fish population in the waters on the island and to determine their relative abundance; concurrently, observations on certain ecological factors affecting the fishes were made. During the course of the work, information which was considered relative to the life histories of the species was gathered. The study furnishes some interesting species-salinity relationships and presents occurrences of certain fishes which have been infrequently reported from waters bordering Mississippi.

PHYSIOGRAPHY

Horn Island lies practically parallel to the mainland with its center in Latitude 30°14′ and Longitude 88°40′. The island is bordered by Horn Island Pass and Dog Keys Pass on the east and west, respectively. The island is some twelve miles long and is approximately three-fourths mile across at the widest point. Foxworth *et al.* (1962) report the length of the island as being fourteen miles in 1944 and further add that the eastern two miles have been removed by storm action in the last several years. Foxworth *et al.* (1962) note that only a small degree of movement or extension of the island has occurred since 1929, and aerial photographs give indications of a "southward shift of the treeless, west one-fourth of the island."

Several theories concerning the formation of the barrier islands in the Mississippi Sound area have been proposed. Price (1954) presented several interesting accounts dealing with the formation of barrier islands in general from previous submarine bars by the action of elevated sea levels, such as during hurricane conditions and states:

> The inference is strong that in each case, a preexisting submarine bar was built higher during a hurricane, so that during the storm it bore the same height relation to the elevated storm sea level as it had formerly borne to the normal level of the Gulf. The bar emerged as a barrier island after the subsidence of the temporarily high sea levels.

Price (1954) remarked on a particular view contending that a barrier island is a feature of an emergent shoreline and states that in his opinion "the great development of active barrier islands on the Gulf coast does not---tell a story of permanent or semipermanent sea level change, or mark either a submergent or emergent shoreline condition." Marion (1951) reported that all of the offshore islands and bars in the Mississippi Sound area were formed due to the deposition of sand by waves and currents, the sand then being "heaped into dunes by winds." The age of Horn Island is estimated to be about six thousand years (Moore 1961).

The factors contributing to the formation on the island of lagoons, ponds, pools, tidal channels, and drainage ditches appear to be numer-

ous. One idea which is outstanding contends that the bodies of water are believed to have been created during storm conditions. For the purpose of the present study a lagoon is considered to be a large body of water several feet in depth. Lagoons are generally surrounded by dense vegetation and may support submerged acquatics. A more descriptive account of lagoons as well as the other bodies of water examined during the course of the study is presented later in the text.

Several lagoons are surrounded by large dunes, and according to Priddy (1964) the presence of a sparse pine forest supported by these dunes indicates an existence of hundreds of years. Priddy noted that presumably the lagoons "were originally huge tide-pools created during severe storm conditions. They are usually situated closer to the Sound because of the progressive growth of the island shoreline Gulfward."

Ponds were probably formed during hurricanes; however, hurricanes are of irregular occurrence and several years may pass without one. A pond shall be defined as a small to medium sized, relatively shallow, murky body of water which may be adjacent or distal to any of the lagoons. Ponds may or may not support vegetation.

Pools, considered in this study to be the smallest bodies of water, were rather clear and shallow. The pools may have originated during storms or may be the result of abnormally high tides during periods of relatively calm conditions. Heavy rainfall is responsible for the formation of some pools. Rainfall on the island is reported to vary from 50 to 70 inches annually (Pessin and Burleigh 1941).

Drainage ditches are either former drainage channels for previously existing inland bodies of water or passages through which hurricane flood waters have flowed. A build-up of the beach front finally led to separation of the majority of ditches from the outer waters, and only one is now influenced by tidal action.

On occasions when hurricanes harass the Mississippi Gulf Coast, the barrier islands generally receive the brunt of the blow. Hurricane Betsy arrived at Grand Isle, Louisiana shortly after nine o'clock PM C.S.T. on September 9, 1965. Extremely high winds from this storm hit Mississippi after midnight, and weather stations in the central part

of the state recorded winds between seventy-five and eighty-five per hour. Tides were at least ten to twelve feet over most of the area from Grand Isle to the Mississippi Coast, and rainfall was recorded as ranging from one to six inches.

Following Betsy both ground and aerial observations were made on several areas of the island, and it was obvious that storm tides had invaded certain pre-existing bodies of water. Infiltrating flood waters undoubtedly altered both the physical and biological aspects of established aquatic environments. Large recently formed bodies of water were not seen, and therefore, it was concluded that the majority of the waters now present on the island are either the result of numerous storms and flood waters or a few tremendous, devastating hurricanes which unleashed their full force directly on the island.

It is assumed that the majority of resident species of fish have gained access to the inland marshes by means of tidal channels and during periods of elevated storm seas which flowed over the island.

MATERIALS AND METHODS

Two vessels, a twenty-two foot fiberglass hull powered by a one hundred and fifty horsepower inboard motor with stern drive and a sixteen foot fiberglass hull powered by a thirty-five horsepower outboard motor, were employed in reaching the island.

All collections were made during daylight hours. Specimens were collected in seines, trammel nets, a cast net, and a brail net. The seines (three) were of twelve, twenty-two, and thirty foot lengths; each having a depth of four feet and a mesh of one-third inch, stretched. The trammel nets (two) were of one hundred and fifty and fifty foot lengths; each with a depth of four feet. The mesh of both nets was one and three-quarters inches, stretched. The cast net and brail net were eight and six feet long, respectively. Both nets were constructed with a one inch mesh, stretched.

Collections were made at designated stations until the writer believed the areas had been sufficiently sampled. Seines were pulled in a manner which was most advantageous at each station and were useful in collecting fishes of various sizes. The seines were carried out several

yards, extended parallel to the bank of the waters being sampled, and then pulled landward. Quite often circumstances prevented this type of seining procedure, such as submerged obstructions and extremely soft, muddy bottoms. This required adjustments in seining in accordance with the situation at hand.

Fishes of moderate to large sizes were captured in trammel nets. The nets were found to be extremely useful at some stations and quite impractical at others. The depth of the water and the nature of the bottom were major factors considered in determining the use of the nets. Trammel nets were usually placed in a manner allowing both ends to reach the same bank. Occasionally an area under investigation was small enough to permit stretching of a net the entire width of the body of water. The usual methods of exciting the fishes such as striking the sides of the skiff, "drumming", and speeding around the net in the skiff were found to be effective in bringing about an entanglement of the fishes. Trammel nets were "set" from a twelve foot aluminum skiff powered by a five and one-half horsepower motor. The skiff was either towed behind or lashed astern the vessel used in reaching the island. Upon going ashore the skiff, motor, nets, and other necessary gear were carried overland to the designated collecting site.

The brail and cast nets were of use in collecting fishes which were adept at avoiding the seines and which were occasionally in waters over bottoms too soft for seining activities.

Specimens were placed in 10 per cent formalin following capture and were identified, counted, measured, and weighed in the laboratory. Occasionally captured fishes were too large to be preserved and brought to the laboratory, and all necessary observations on these specimens were conducted in the field.

Measurements on fishes were made by employing either measuring boards or measuring sticks. Total lengths (from the tip of the snout to the tip of the longest caudal fin ray) and standard length (from the tip of the snout to the posterior edge of the hypural plate) were taken with few exceptions on all fishes collected. All measurements were recorded in millimeters (mm.), and the writer has presented the measurements in this form unless otherwise stated.

The majority of fishes were dried by blotting, and weight determinations were then made by means of a Top Loading Precision Mettler Balance. Large fishes were weighed on heavy-weight scales. Weights were noted to the nearest one-tenth gram and have been reported as such unless stated differently.

The stomachs of several specimens were examined, and this information is related in a species account. Gonadal examinations were not made during the present study.

Several specimens were deposited in the museum of the Gulf Coast Research Laboratory; however, the majority of collected fishes form a portion of the writer's personal collection.

Water samples were taken at all stations during every collecting period. Salinity in parts per thousand was later determined in the laboratory by means of a hydrometer. The abbreviation ppt. is largely used throughout this work rather than parts per thousand.

Temperatures, air and water, were read to the nearest tenth of a degree (Celsius) from a mercury thermometer. The majority of areas examined were rather shallow, and only a top water reading was taken with the thermometer being placed just below the surface. During periods of extended collecting, temperature readings were frequently taken.

Types of vegetation, condition of the bottom, turbidity of the water, the state of the tide and effect (if any), and hours of collecting (AM or PM) were noted during each collecting session.

STATIONS

An effort was made to sample all bodies of water on the island and to make as many collections as deemed necessary at each place. This resulted in specimens being acquired through 194 net hauls. Adjustments in collecting methods were made in accordance with the nature of the area under consideration.

Forty-nine collecting stations were established (Figure 2), and the nature of each warrants classification under one of six major categories.

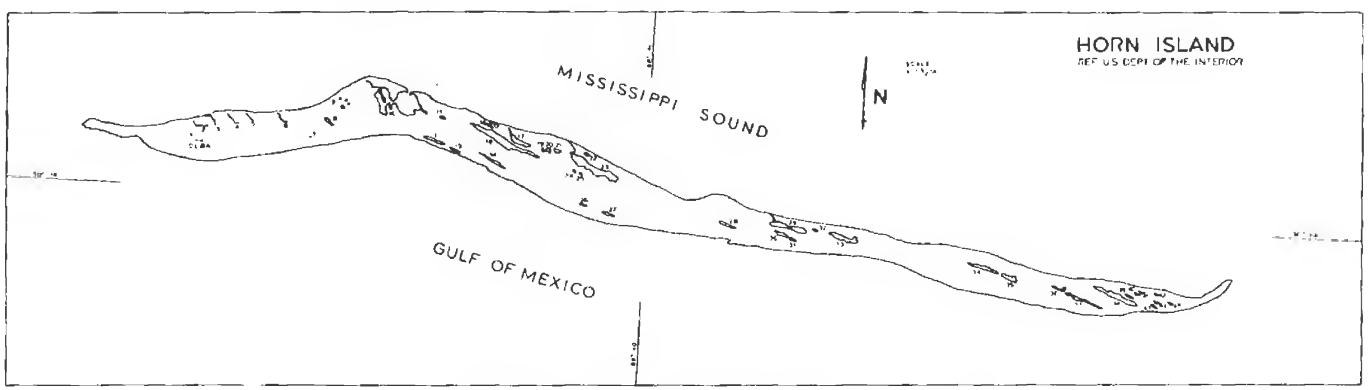

Figure 2. Horn Island Collecting Stations

Each station is characterized in detail in table 1, and the following discussion summarizes the principal lineaments of each major category.

Tidal lagoon which is permanently connected with Mississippi Sound

Only one lagoon, station 10 (Figure 3), was placed in this category. A short, tidal channel, some seventy feet long and thirty feet wide, permitted exchange of tidal waters from Mississippi Sound and the lagoon. The receding waters of ebb tide flowed quite rapidly through the channel, and at this time fishes were seldom observed moving either with the outgoing tide or against the current.

During the present study salinities in the lagoon ranged from 23.0 to 29.9 ppt. Water temperatures ranged from 18.4 to 31.0 C.

Oyster-grass, *Spartina alterniflora*, broom-grass, *Andropogon sp.*, and black rush, *Juncus roemarianus,* were the most conspicuous forms of vegetation bordering the lagoon. Thick growths of widgeon-grass or ditch-grass, *Ruppia maritima,* existed for some distance offshore and during high tide were practically submerged. Algae was the prominent form of vegetation within the tidal channel. Strands of sea oats, *Uniola paniculata,* were observed on bordering sand dunes.

The bottom ranged from hard sand near the banks of the lagoon to extremely soft, black mud in the center.

Fishes were collected both in the deeper areas of the lagoon and in the surrounding marsh. During high tide flooding of the marsh was often observed. A most interesting variety of fishes was collected from the lagoon, and it may be noted that prominent in both numbers and regular appearance were *Cyprinodon variegatus, Fundulus similis, Gambusia affinis, Lucania parva, Poecilia latipinna, and Menidia beryllina.* Of notable interest was the capture of a young lemon shark, *Negaprion brevirostris.*

An artesian well constantly supplies fresh water to the northwest section of the lagoon.

Figure 3. An aerial view of station 10, the tidal lagoon which is permanently connected with Mississippi Sound (in foreground). The Gulf of Mexico is shown uppermost.

Lagoons and ponds which are usually connected with Mississippi Sound during high tide by means of tidal channels

Lagoons and ponds in this category are temporarily influenced by Mississippi Sound during high tide by means of channels or water courses which wind through the marshes and terminate on the Sound beach (Figure 4). Of course abnormal storm tides also overflow into these areas. Channels varied in length from 150 to 200 feet (front point of connection with Mississippi Sound to the inland lagoon or pond). During low tide a strip of beach usually five to fifteen feet in width separated the channels from the Sound. None of the waters in this category or in any category connected with the Gulf of Mexico on the south shore of the island.

Lagoons appeared to be only slightly affected by tidal changes; however, several ponds either became entirely drained or retained water measuring only several inches in depth during low tide. Ponds which were not completely drained were often observed to be quite active with fishes. At other times such ponds appeared to be practically devoid of fishes, an observation which was supported by poor catches. The latter suggests either an outward movement of fishes with the ebbing tide or an invasion of the surrounding marshlands.

Salinities in the lagoons and ponds ranged from 20.0 to 27.0 ppt., and water temperatures ranged from 21.7 to 32.5^{0}C.

The majority of areas examined were surrounded by *Juncus roemerianus, Spartina alterniflora, Andropogon sp., Scirpus sp.* and quite often saw-grass, *Caldium jamaicensis. Ectocarpus sp.* was collected on several occasions.

Bottoms in this category were quite similar, being composed primarily of soft, thick mud mixed with a small quantity of sand.

The fishes most prominent in these waters were *Cyprinodon variegatus, Fundulus grandis, Fundulus similis, Gambusia affinis, Poecilia latipinna,* and *Menidia beryllina.* Collections made during high, ebbing, and low tides proved to vary only slightly in the catches.

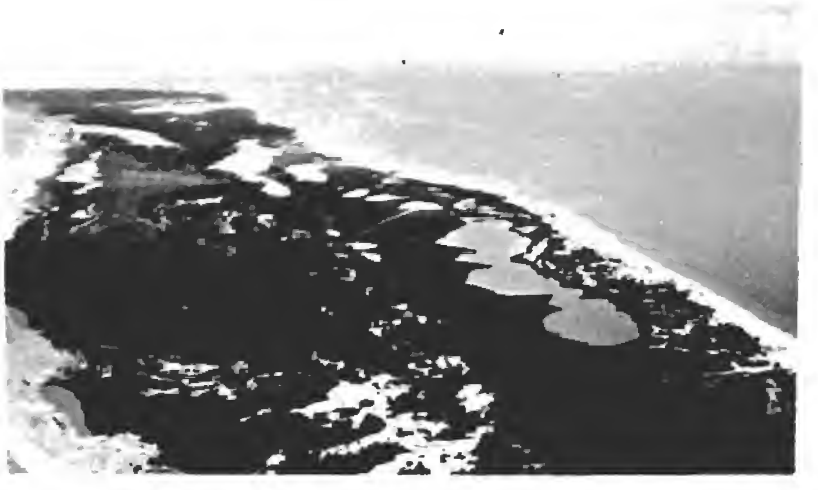

Figure 4. An aerial view of a section of the island (westward direction). Mississippi Sound is to the right and the Gulf of Mexico is to the left. Station 23, a tidal lagoon, is shown in the lower right.

Figure 5 An aerial view of Station 38, a landlocked lagoon which is located on the east en of the island. Mississippi Sound is shown in the foreground, and the Gulf of Mexic and Petit Bois Island lie in the background.

Figure 6 An aerial view of station 33, a landlocked lagoon near the center of the island. Tall pinetrees line the Sound beach (uppermost).

Figure 7. An aerial view of the "potholes" (station 1a, 1b, 1c, and 1d from left to right). A portion of the Gulf beach is shown uppermost.

Lagoons and ponds which are isolated except during abnormally high tides

Landlocked bodies of water are considered to be permanent features on the island, and only periodically are they affected by outside waters during maximum storm tides (Figures 5, 6 and 7).

Within this category four small ponds, designated as stations Ia, Ib, Ic, and Id (Figure 7), which are located in a marsh near the west end of the island were of considerable interest. The so-called "pot holes" were formed by igniting a mixture of ammonium nitrate and diesel fuel, and the dimensions of these areas are given in table 1. The purpose of forming the small water holes was in an attempt to attract water fowl to the area. The project was conducted by the Gulf Island National Wildlife Refuges. The blasting occurred in April 1966, and shortly thereafter the holes were filled with water and supported fishes which presumably infiltrated from the surrounding marsh.

The salinity range for waters in this category was from 0.6 to 27.1 ppt. The temperature range was from 18.4 to 33.5°C.

Vegetation consisted primarily of *Spartina alterniflora* and *Juncus roemerianus.* The majority of areas examined were brackish and scattered growths of *Ruppia maritima* were frequently observed. *Caldium jamaicense* and nearby clumps of rosemary, *Ceratiola ericoides,* were often noted.

Characteristic bottoms were either of hard sand or extremely soft mud which would rarely support human weight, and in many areas walking was entirely impossible. The bottoms were usually quite thick with decayed organic material and the odor of hydrogen sulfide gas was often quite noticeable.

These enclosed waters were inhabited by a large variety of fishes and yielded some of the most interesting catches such as *Alutera schoepfi, Lepisosteus spatula, Megalops atlanticus, Sciaenops ocellatus,* and *Sphyraena barracuda.* Numerous other species were collected, and of these cyprinodonts and poeciliids were most prominent from the standpoint of both numbers and regular appearance.

Alligators, *Alligator mississippiensis,* were encountered occasionally, and cottonmouth moccasins, *Agkistrodon piscivorus,* were quite abundant at several ponds.

Pools formed by receding hurricane waters

In this category pools were located either near the shoreline of the island or some distance inland in an area through which receding hurricane flood waters had flowed. Shortly after the passing of Hurricane Betsy several pools were discovered on the Gulf beach of the island. This area was previously devoid of any such pools.

Fishes inhabiting the pools were species which probably were swept seaward as flood waters receded from the inland marshes and bodies of water. At this time fishes concentrated in small, shallow pools such as those examined on the Gulf beach. Due to their juxtaposition all sampled pools were considered as composing one station, 7.

The salinity and temperature readings obtained from all pools were identical; these being 24.8 ppt. and 32.5^{0}C., respectively.

Three species of fish, *Eleotris pisonis, Evorthodus lyricus,* and *Lucania parva,* were taken from the pools.

Ditches

Located on the western two miles of the island and near Mississippi Sound are five elongate, rather narrow bodies of water which are designated as ditches. One ditch, station 3, is usually connected with the Sound during high tide (Figure 8); however, the remaining four are separated from the Sound by approximately twenty-five feet of beach. It is assumed that all of the ditches may at times become open to the Sound, and at a later time again become isolated. Adverse weather conditions would tend to be the influencing agent in this case.

The five ditches were similar in maximum depth, three to four feet, and were bordered by rather high banks. The ditches ranged from twenty-five to one hundred yards in length and varied from four

Figure 8. An aerial view of station 3, a ditch which is open to Mississippi Sound during high tide.

to twelve feet in width. A winding nature was characteristic of all ditches, and each was terminated inland near the center of the island, usually becoming confluent with adjacent marshes.

Salinities ranged from 5.0 to 29.0 ppt.; however, the four land-locked ditches had a mean salinity of 6.6 ppt. The relatively high reading of 29.0 ppt. was obtained from the drainiage ditch which was influenced by Mississippi Sound during high tide. Temperatures ranged from 14.1 to 31.5^{0}C.

All ditches were similar in bottom composition which was primarily a mixture of sand and soft mud.

The most conspicuous forms of vegetation lining the banks of each ditch were *Juncus roemerianus,* arrow-grass, *Sagittaria sp.,* and *Spartina alterniflora. Ectocarpus* was the only algal form noted.

Cyprinodonts and poeciliids were most abundant in numbers and were the most regularly encountered species. *Mugil curema, Mugil cephalus,* and *Menidia beryllina* were somewhat consistently taken. Other species were collected less often and were not found in appreciable numbers.

Several alligators, *Alligator mississippiensis,* were observed on several occasions.

Temporary rainwater pools

During periods of heavy rainfall temporary pools measuring several inches in depth were formed on many areas of the island. The freshwater pools were generally small and were usually situated near or among strands of slash pine, *Pinus elliotii.* The pools were notably subject to rapid evaporation and absorption, leaving no discernible indications of their former existence.

Upon examination of two such pools, stations 9a and 9b, *Gambusia affinis* and *Lucania parva* were the only species collected. The fishes presumably gained entrance into the pools from nearby marshes.

TABLE 1

STATION INFORMATION

STATION	MAXIMUM DIAMETERS	MAXIMUM DEPTH	BOTTOM COMPOSITION	VEGETATION SUBMERGED	VEGETATION SHORE	SALINITY (ppt.) RANGE	SALINITY (ppt.) MEAN	WATER TEMPERATURE RANGE	WATER TEMPERATURE MEAN	NUMBER OF VISITS	NUMBER OF SPECIES COLLECTED	NUMBER OF SPECIMENS COLLECTED	PERCENTAGE OF TOTAL CATCH AT EACH STATION FOR MOST ABUNDANT SPECIES
TIDAL LAGOON PERMANENTLY CONNECTED WITH MISSISSIPPI SOUND													
10	1,350'x3,000'	6.0'	Mud & Sand	Patches of Ruppia, Ectocarpus	Juncus, Spartina, Scirpus, Andropogon, Nearby strands of Uniola	23.0-29.9	26.8	18.4-31.0	26.8	6	40	6,688	P. latipinna 24.3 M. beryllina 18.5 G. affinis 17.8 F. similis 14.0 C. variegatus 11.9 C. variegatus 11.9
LAGOONS AND PONDS WHICH ARE USUALLY CONNECTED WITH MISSISSIPPI SOUND DURING HIGH TIDE BY MEANS OF TIDAL CHANNELS													
17	180'x600'	5.0'	Mud and Sand	Patches of Ruppia	Spartina	7.5	7.5	29.2-31.0	30.1	1	13	184	L. parva 47.3 P. latipinna 18.5
23	600'x3,000'	4.0'	Mud and Sand	Patches of Ruppia Ectocarpus	Juncus Spartina, Scirpus, Andropogon	23.0-27.0	25.6	26.9-32.5	30.6	4	17	6,018	F. similis 21.2 M. beryllina 21.2 G. affinis 19.8 C. variegatus 19.2 P. latipinna 17.1
29	180'x2,000'	4.0'	Mud and Sand	Strands of Ruppia, Ectocarpus	Juncus, Spartina	22.7	22.7	21.7-22.2	21.9	1	13	194	M. beryllina 82.6 F. similis 5.2
LAGOON AND PONDS WHICH ARE ISOLATED EXCEPT DURING ABNORMALLY HIGH TIDES													
1A	15'x25'	3.0'	Sand	None	Juncus Spartina	1.7	1.7	32.7	32.7	1	8	58	P. latipinna 49.1 C. variegatus 20.8
1B	12'x20'	3.0'	Sand	None	Juncus Spartina	1.7	1.7	32.7	32.7	1	8	115	P. latipinna 67.8 C. variegatus 27.3
1C	15'x15'	3.0'	Sand	None	Juncus Spartina	1.7	1.7	32.8	32.8	1	8	50	P. latipinna 30.9 C. variegatus 27.3
1D	12'x12'	2.0	Sand	None	Juncus Spartina	1.7	1.7	32.8	32.8	1	8	69	P. latipinna 39.0 C. variegatus 22.0
8	30'x150'	4.0'	Thick, black mud	Patches of of Rupia	Juncus, Spartina, Typha, Nearby strands of Uniola	3.9	3.9	26.9	26.9	1	3	34	F. similis 82.4 C. variegatus 14.7
11	180'x240'	5.0' -	Thick, black mud	None	Juncus, Spartina, Nearby Cladium	5.1	5.1	33.0	33.0	1	9	116	M. beryllina 91.7 F. grandis 14.0 M. cephalus 14.0
12	120'x650'	4.0'	Mud and Sand	None	Juncus Spartina	7.2	7.2	18.9-20.8	19.9	1	10	21	P. latipinna 28.6 F. similis 23.8
13	120'x300'	6.0''	Mud and Sand	Small patches of Ruppia	Juncus Spartina	12.1	12.1	20.0	20.0	1	6	145	M. beryllina 91.7

Table 1 (continued)

STATION	MAXIMUM DIAMETERS	MAXIMUM DEPTH	BOTTOM COMPOSITION	VEGETATION SUBMERGED	VEGETATION SHORE	SALINITY (ppt.) RANGE	SALINITY (ppt.) MEAN	WATER TEMPERATURE RANGE	WATER TEMPERATURE MEAN	NUMBER OF VISITS	NUMBER OF SPECIES COLLECTED	NUMBER OF SPECIMENS COLLECTED	PERCENTAGE OF TOTAL CATCH AT EACH STATION FOR MOST ABUNDANT SPECIES
14	150'x650'	4.0'	Mud and Sand	Small patches of Ruppia	Juncus Spartina	9.3	9.3	20.8-21.4	21.1	1	8	140	L. parva 52.8 C. variegatus 19.3
15	75'x150'	2.5'	Thick, black mud	None	Sagittaria, Spartina, Nearby Cladium	2.2	2.2	33.3-33.5	33.4	1	9	139	L. parva 47.3 P. latipinna 18.5
16	30'x100'	4.0'	Sand and soft, black mud	Ectocarpus	Spartina, nearby Cladium	20.0-26.9	23.3	26.5-30.5	28.2	2	10	255	F. similis 40.4 C. variegatus 23.9 A. xenica 19.2
18	450'x500'	6.0'	Mud and sand	Strands of Ruppia, Ectocarpus	Spartina	7.0-13.3	9.5	29.4-32.0	31.2	3	22	6,299	P. latipinna 24.9 M. beryllina 21.9 G. affinis 17.5 F. similis 17.2 C. variegatus 16.5
19	100'x180'	1.5'	Mud and Sand	Patches of Ruppia	Spartina	15.1	15.1	29.1-30.0	29.6	1	7	183	F. similis 33.3 A. xenica 22.4 C. variegatus 20.2 P. latipinna 18.0
20	140'x200'	2.0'	Mud and Sand	Patches of Ruppia	Spartina	15.1	15.1	30.4	30.4	1	5	157	C. variegatus 33.1 P. latipinna 31.2 F. similis 25.5
21	150'x250'	2.0'	Sand	Patches of Ruppia	Spartina	14.3	14.3	30.7-32.6	31.7	1	4	146	P. latipinna 50.0 C. variegatus 32.9
22	5'x5'	8.0'	Mud and sand	None	Juncus, Spartina	16.5	16.5	27.1	27.1	1	4	95	A. xenica 57.9 C. variegatus 38.9
24	100'x150'	1.5'	Sand and soft, black mud	None	Juncus, Spartina	4.6	4.6	30.3	30.3	1	5	180	C. variegatus 40.0 P. latipinna 35.0
25	75'x150'	1.5'	Sand and soft, black mud	None	Nearby Cladium	4.8	4.8	30.5	30.5	1	4	196	P. latipinna 72.4 C. variegatus 15.8
26	45'x300'	3.5'	Mud and Sand	None	Spartina	13.1	13.1	29.1-31.3	30.0	1	2	38	G. affinis 78.9 F. similis 21.1
27	100'x450'	3.0'	Mud and sand	None	Spartina	12.4	12.4	31.8	31.8	1	3	41	G. affinis 56.1 M. beryllina 34.1
28	130'x750'	3.0'	Mud and sand	Patches of Ruppia	Juncus, Spartina	3.0	3.0	29.4-30.8	30.1	1	5	80	P. latipinna 43.8 M. beryllina 27.5
30	150'x525'	2.0'	Mud and sand	Patches of Ruppia	Juncus, Spartina	2.6	2.6	21.0	21.0	1	4	37	M. beryllina 45.9 F. similis 29.7
31	75'x200'	1.5'	Mud and sand	Patches of Ruppia	Juncus, Spartina	2.1	2.1	21.1	21.1	1	4	38	M. beryllina 44.7 F. similis 44.7
32	75'x180'	8.0''	Mud and Sand	None	Juncus, Spartina	11.3	11.3	21.2	21.2	1	4	44	P. latipinna 52.3 M. beryllina 22.7
33	240'x1,400'	6.5'	Sand and soft, black mud	Strands of Ruppia Ectocarpus	Juncus, Spartina, Sagittaria	0.6	0.6	31.8-32.5	32.2	1	9	499	P. latipinna 59.1 G. affinis 14.4 C. variegatus 10.4 L. parva 10.0

Table 1 (continued)

STATION	MAXIMUM DIAMETERS	MAXIMUM DEPTH	BOTTOM COMPOSITION	VEGETATION SUBMERGED	VEGETATION SHORE	SALINITY (ppt.) RANGE	SALINITY (ppt.) MEAN	WATER TEMPERATURE RANGE	WATER TEMPERATURE MEAN	NUMBER OF VISITS	NUMBER OF SPECIES COLLECTED	NUMBER OF SPECIMENS COLLECTED	PERCENTAGE OF TOTAL CATCH AT EACH STATION FOR MOST ABUNDANT SPECIES
34	180'x400'	2.5'	Sand and soft, black mud	Strands of Ruppia	Juncus, Sagittaria, Spartina	19.0	19.0	29.1-31.0	30.1	1	8	133	L. parva 77.4 C. variegatus 10.5
35	250'x750'	2.5'	Sand and soft, black mud	Strands of Ruppia	Juncus, Spartina, Sagittaria	18.3	18.3	31.7-32.0	31.9	1	9	152	M. beryllina 39.5 L. parva 27.6
36	200'x600'	3.0'	Sand and soft, black mud	None	Juncus, Spartina	10.8	10.8	31.0-31.5	31.3	1	6	197	C. variegatus 45.7 P. latipinna 20.8
371	185'x3,200'	3.5'	Sand and soft, black mud	None	Juncus, Spartina	11.0	11.0	31.6-31.8	31.7	1	7	254	C. variegatus 48.6 M. beryllina 25.3
38	250'x2,300'	6.5'	Sand and soft, black mud	Numerous Patches of Ruppia	Juncus, Spartina	17.1-18.0	17.6	18.4-32.6	25.3	2	30	566	C. variegatus 48.6 M. beryllina 25.3
39	30'x100'	1.0'	Sand and soft, black mud	None	Juncus, Spartina Nearby clumps of Ceratiola	21.5	21.5	21.0	21.0	1	6	830	G. affinis 54.9 P. latipinna 32.9 C. variegatus 10.6
40	30'x100'	1.0'	Sand and soft, black mud	None	Juncus, Spartina, Nearby clumps of Ceratiola	27.1	27.1	18.5	18.5	1	5	566	G. affinis 60.8 P. latipinna 28.4
41	30'x75'	2.0'	Sand and soft, black mud	None	Juncus, Spartina, Nearby clumps of Ceratiola	27.1	27.1	18.5	18.5	1	3	157	C. variegatus 52.9 G. affinis 35.7
42	25'x60'	1.0'	Sand and soft, black mud	None	Juncus Spartina, Nearby clumps of Ceratiola	22.5	22.5	19.0	19.0	1	4	282	P. latipinna 78.7 C. variegatus 19.1
43	35'x60'	1.0'	Sand and soft, black mud	None	Juncus, Spartina, Nearby clumps of Ceratiola	21.5	21.5	20.8	20.8	1	4	433	L. parva 55.0 P. latipinna 41.6
44	60'x80'	2.0'	Sand and soft, black mud	None	Juncus, Spartina Nearby clumps of Ceratiola	27.0	27.0	21.0	21.0	1	4	1,084	L. parva 53.8 P. latipinna 40.1
4 45	25'x60'	2.0'	Sand and soft, black mud	None	Juncus, Spartina, Nearby clumps of Ceratiola	22.5	22.5	20.5	20.5	1	3	559	L. parva 95.9 M. beryllina 2.3
					POOLS FORMED DURING RECEDING HURRICANE WATERS								
7	2'x8'	4.0"	Mud and sand	None	None	24.6	24.8	32.5	32.5	1	3	55	L. parva 76.4 E. prosnis 14.6

Table 1 (continued)

STATION	MAXIMUM DIAMETERS	MAXIMUM DEPTH	BOTTOM COMPOSITION	VEGETATION SUBMERGED	VEGETATION SHORE	SALINITY (ppt.) RANGE	SALINITY (ppt.) MEAN	WATER TEMPERATURE RANGE	WATER TEMPERATURE MEAN	NUMBER OF VISITS	NUMBER OF SPECIES COLLECTED	NUMBER OF SPECIMENS COLLECTED	PERCENTAGE OF TOTAL CATCH AT EACH STATION FOR MOST ABUNDANT SPECIES
					DITCHES								
2	8'x300'	3.0'	Mud and Sand	Patches of Ruppia	Juncus, Spartina, Sagittaria	5.0-9.1	6.6	16.5-31.5	22.6	3	11	244	C. variegatus 48.4 M. beryllina 18.4 M. cephalus 10.7
3	5'x180'	3.5'	Sand	None	Juncus (old strands)	5.3	5.3	14.1	14.1	1	6	73	M. curema 43.6 P. latipinna 28.8 M. beryllina 23.3
4	5'x180'	3.0'	Mud and sand	Masses of Ectocarpus	Juncus (old strands)	5.2-13.1	9.2	16.0-20.5	18.3	2	8	321	M. cephalus 93.5
5	10'x200'	4.0'	Sand	Patches of Ruppia, Ectocarpus	Juncus (old strands)	29.0	29.0	26.5	26.5	1	8	198	M. Beryllina 82.8 F. similis 10.6
6	10'x85'	3.0'	Sand	Patches of Ruppia, Ectocarpus	Juncus (old strands)	5.5	5.5	30.0	30.0	1	7	175	P. latipinna 62.9 C. variegatus 25.1
					TEMPORARY RAINWATER POOLS								
9A	15'x25'	3.0''	Sand	None	Nearby Ceratiola and Pinus	-Fresh-		28.6	28.6	1	2	24	G. affinis 58.3 L. parva 41.7
9B	6'x15'	3.0''	Sand	None	Nearby Ceratiola and Pinus	-Fresh-		28.7	28.7	1	2	35	G. affinis 48.5 L. parva 51.5

HYDROGRAPHY

The present study was conducted only during the fall, winter, and summer; therefore, temperature readings for an entire year were not obtained. Wide fluctuations in water temperatures were noted for the periods during which the temperature data were recorded (table 2). This was to be expected in shallow waters such as those examined in the present investigation.

Water temperatures closely followed air temperatures. During periods of declining air temperatures a noticeable drop in water temperatures was also observed. The same relationship was noted during a rise in air temperatures with the water becoming warmer. Data show that with only one exception, in July, the air temperature was somewhat higher than that of the water.

December, January, and February are the cold months in the waters of the bays and shallow Gulf with January being the coldest for all bodies of water (Gunter, 1945). The lowest water temperatures recorded during the present study were in late December (14.1°C.) and in early January (16.0°C.). The highest water temperatures were observed in early June (33.0°C.) and in late July (33.5°C.).

Salinity

During this study the waters examined ranged from fresh to 29.9 ppt. Table 3 shows all dates of collecting, and the salinity of the water for the station under investigation. Rainwater ponds account for the presence of fresh water. In Mississippi Sound there is usually a gradient from low salinity in the bays to a relatively high salinity in the passes between the barrier islands. The majority of high salinity waters encountered were those of tidal lagoons into which water from Mississippi Sound has access through tidal channels. Salinities of the tidal lagoons were noted to be highest during late fall and lowest during the summer which appears to be in agreement with an observation on the Sound waters by Moore (1961).

A wide range, 0.6 to 27.1 ppt., was noted for the landlocked bodies of water. Hypersalinity was expected for several areas due to evaporation; however, such was not the case. Fresh water is supplied

to many landlocked areas from artesian wells, several of which were observed by the writer. In addition rainfall also affects the salinity. In the area of study the annual rainfall is generally evenly distributed; however, occasionally harsh tropical disturbances in the Gulf of Mexico instigate an increase in rainfall. In several areas where topography permitted, seepage was probably an important factor in maintaining moderate salinities.

TABLE 2

NUMBER OF READINGS, RANGE, AND MEAN WATER TEMPERATURES (DEGREES C.) RECORDED FOR STATIONS DURING EACH COLLECTION PERIOD

DATE		STATIONS	NUMBER OF READINGS	RANGE	MEAN
1965					
August	18	10	3	29.3 - 31.0	30.3
September	22	10	4	28.2 - 28.9	28.6
October	12	16	2	26.5 - 26.9	26.7
October	19	5, 7, 8	3	26.5 - 32.5	28.6
October	22	9a, 9b	2	28.6 - 28.7	28.7
October	27	22, 23	2	26.9 - 27.1	27.0
November	2	29	3	21.7 - 22.2	21.9
November	4	20 - 32	3	21.0 - 21.2	21.1
November	11	39 - 45	7	18.5 - 21.0	19.9
November	17	38	3	18.4 - 18.9	18.7
November	19	13, 14	3	20.0 - 21.4	20.7
November	21	12	2	18.9 - 20.8	19.9
November	24	2, 4	2	20.0 - 20.5	20.3
November	26	10	3	18.4 - 19.0	18.7
December	22	2, 3	2	14.1 - 16.5	15.3
1966					
January	10	4	1	16.0	---
June	9	10	3	25.1 - 26.0	25.6
June	15	16, 18	4	29.9 - 31.5	30.8
June	17	2	1	31.5	---
June	20	23	3	31.1 - 32.0	31.6
June	24	24,25	2	30.3 - 30.5	30.4
July	2	10	4	27.0 - 28.0	27.6
July	4	26, 27	4	29.1 – 31.8	30.3
July	6	11	1	33.0	---
July	11	28	2	29.4 - 30.8	30.1
July	19	23	3	28.6 - 31.0	29.7
July	21	6	1	30.0	---
July	23	17	2	29.2 - 31.0	30.1
July	25	19, 20	4	29.1 - 30.4	29.8
July	26	21	2	30.7 - 32.6	31.7
July	27	1a, 1b, 1c, 1d	4	32.7 - 32.8	32.8
July	29	15	2	33.3 - 33.5	33.4
July	30	18	2	31.8 - 32.0	31.9

TABLE 2
(continued)

DATE		STATIONS	NUMBER OF READINGS	RANGE	MEAN
August	2	10	3	28.9 - 30.0	29.5
August	9	1a	1	29.5	---
August	15	18	2	29.4 - 31.0	30.2
August	20	23	2	31.6 - 32.5	32.1
August	23	33	2	31.8 - 32.5	32.2
August	26	34, 35	4	29.1 - 32.0	30.9
August	29	36, 37	4	31.0 - 31.8	31.5
September	1	38	3	31.3 - 32.5	32.0

TABLE 3

SALINITIES RECORDED FOR STATIONS DURING EACH COLLECTION PERIOD

DATE		STATION	SALINITY (ppt.)
1965			
August	18	10	28.3
September	22	10	29.0
October	12	16	20.0, 23.0*
October	19	5	29.0
October	19	7	24.8
October	19	8	3.9
October	22	9a	Fresh
October	22	9b	Fresh
October	27	22	23.0
October	27	23	16.5
November	2	29	22.7
November	4	30	2.6
November	4	31	2.1
November	4	32	11.3
November	11	39	21.5
November	11	40	27.1
November	11	41	27.1
November	11	42	22.5
November	11	43	21.5
November	11	44	27.0
November	11	45	22.5
November	17	38	17.1
November	19	13	12.1
November	19	14	9.3
November	21	12	7.2
November	24	2	9.1
November	24	4	13.1
November	26	10	29.9
December	22	2	5.0
December	22	3	5.3
1966			
January	10	4	5.2
June	9	10	23.0
June	15	16	24.8, 26.9*

TABLE 3
(continued)

DATE		STATION	SALINITY (ppt.)
June	15	18	13.3
June	17	2	5.6
June	20	23	27.0
June	24	24	4.6
June	24	25	4.8
July	2	10	26.0
July	4	26	13.1
July	4	27	12.4
July	6	11	5.1
July	11	28	3.0
July	19	23	26.4
July	21	6	5.5
July	23	17	7.5
July	25	19	15.1
July	26	21	14.3
July	27	1a	1.7
July	27	1b	1.7
July	27	1c	1.7
July	27	1d	1.7
July	29	15	2.2
July	30	18	7.0
August	2	10	24.5
August	9	1a	1.7
August	15	18	8.1
August	20	23	26.1
August	23	33	0.6
August	26	34	19.0
August	26	35	18.3
August	29	36	10.8
August	29	37	11.0
September	1	38	18.0

* On October 12, 1965 and June 15, 1966 two salinities were recorded for station 16. The first reading corresponds to the inland pond and the second to an associated ditch line.

ANNOTATED LIST OF SPECIES

A total of 69 species representing 58 genera and 35 families was collected, and a systematic account of the fishes was prepared. For species which were taken in abundance a catch record table follows the individual species discussion. The entire data are given within the body of the species account for the less abundant species.

Class Chondrichthyes

Order Squaliformes

Family Carcharhinidae - Requiem sharks

Negaprion brevirostris (Poey). Lemon shark

One small female *N. brevirostris* was captured in a trammel net in July 1966 at station 10 in three feet of water. This catch apparently constitutes the first record of *N. brevirostris* from the Mississippi Sound area. The shark measured 925 mm. in total length and weighed 4,535.9 gms. (ten pounds). The temperature and salinity of the water were 28.0° C. and 26.0 ppt., respectively.

At the time of capture the tide was falling and water was leaving the shallow lagoon by means of the tidal channel. The shark could possibly have been feeding, since at the instant of capture several croakers, *Micropogon undulatus*, mullet, *Mugil cephalus*, and spot *Leiostomus xanthurus*, also became ensnared in the net. The shark's stomach was not examined, but unidentifiable material was regurgitated shortly after capture. Springer (1950) noted that most data indicate the lemon shark's (especially the young) preference for shallow water, and "it seems probable that its presence in or over deep water is transitory. "Gunter (1945) reported one lemon shark which measured 64.5 cm. in length, and added that the specimen was the first lemon shark recorded from Texas waters.

The small shark taken by the writer was probably born in early spring, Clark and von Schmidt (1965) examined seventy-five lemon sharks, and their records indicated that mating activity reaches a peak in the spring in Florida. They reported that in May the catches of both sexes increased greatly, and from this they surmised that "this increase may be due to three factors; the gathering of males and non-gravid females for mating; the arrival of near term gravid females ready to release their young in shallow waters; and increased fishing in 1962 and 1963 at this time of the year for this species ... "Springer (1938) obtained two young lemon sharks, measuring 624 and 630 mm. in length, with open umbilical scars and noted that an increase in length of 100 mm. in the first month is probably normal. Casey (1964) gave the size at birth as being about 25 inches.

Family Sphyrnidae - Hammerhead sharks

Sphyrna tiburo (Linnaeus). Bonnethead shark

One small, male bonnethead shark measuring 360.0 mm. in total length and weighing 172.2 gms. was collected in early August 1966.

The specimen was captured in a trammel net at station 10. At the time of capture the temperature and salinity were 30.0°C. and 24.5 ppt. respectively.

Clark and von Schmidt (1965) noted that this species may have a continuous mating season, or mating may occur during spring and fall. Hoese and Moore (1958) presented information on foetal young of *S. tiburo* and on five very young specimens which were collected during the latter part of August. These specimens ranged from 342 to 369 mm. in length and were "recently born as the stomachs were still empty and the intestine still contained meconium." From this information it is surmised that the specimen taken by the writer was of recent birth.

Order Rajiformes

Family Dasyatidae - Stingrays

Dasyatis sabina (LeSueur). Stingaree

Three stingarees were taken by seining. One specimen was collected in October 1965 at station 16. The fish measured 213 mm. in disc width and 574 mm. in total length and weighed 411.6 gms. The temperature was 26.5°C., and the salinity was 23.0 ppt. Two stingarees were captured in June 1966 at station 18. The specimens measured 116 and 129 mm. in disc width and 322 and 347 mm. in total length and weighed 70.4 and 97.2 gms., respectively. The temperature was 31.5°C., and the salinity was 13.3 ppt.

Gunter (1938) recorded this species up rivers as far as two hundred miles. Gunter (1942) categorized this fish as euryhaline, and remarked that *D. sabina* is the most abundant member of this genus in the shallow waters on the northern Gulf of Mexico.

Class Osteichthyes

Order Semionotiformes

Family Lepisosteidae - Gars

Lepisosteus oculatus (Winchell). Spotted gar

One spotted gar was taken in a trammel net at station 33 in August 1966. The specimen measured 504 mm. in total length and weighed 721.0 gms. The temperature and salinity at the time of capture were 32.5°C. and 0.6 ppt., respectively. Gunter (1945) said this species only ventures into waters of low salinity. Suttkus (1963) noted that this species of gar does not invade brackish or marine waters as much as either the alligator or longnose gars.

Lepisosteus oculatus and the Florida gar are the least tolerant of saline conditions. Gunter and Knapp (1951) compared the salinity ranges of all four species of gars.

It may be surmised that the gar reached the island during a period when the surface waters of Mississippi Sound were of a rather low salinity. Apparently high waters enabled the fish to gain entrance into station 33.

Lepisosteus spatulus Lacépède. Alligator gar

Nineteen specimens were taken during the present study, and in addition to the individuals collected several alligator gars were observed surfacing as well as escaping trammel nets.

Catch data are given in table 1, and measurements are in total length only. *Lepisosteus spatula* was taken at temperatures ranging from 29.2 to 32.5°C. and salinities ranging from 0.6 to 18.0 ppt. Salinity and temperature data are not available for a single specimen collected in March 1966. Gunter (1945) noted that apparently the alligator gar, a euryhaline species, prefers low salinity waters.

Stomachs of several specimens were examined and were found to contain the blue crab. *Callinectes sapidus*, as well as varying quantities of unidentifiable material.

TABLE 1 - Lepisosteus spatula

Date	Station	No of Specimens	Total Length (cm)	Weight (kg)	Water Temperature*	Salinity (ppt)
1966						
March	15	1	36.9	0.9	---	---
July 23	17	1	67.2	0.5	29.2	7.5
Aug 23	33	11	75.3-139.5	4.5-27.2	31.8	0.6
Sept 1	38	6	88.0-130.0	9.0-19.9	32.5	18.0
					Mean Salinity	6.8

*Water Temperatures are presented in Degrees Celsius.

Order Clupeiformes

Family Elopidae - Tenpounders and Tarpons

Elops saurus Linnaeus. Tenpounder

Two specimens were captured in trammel nets. One fish measuring 234 mm. in standard length and 288 mm. in total length and weighing 126.0 gms. was taken at station 29 in November 1965. The temperature and salinity were 21.9^{0}C. and 22.7 ppt., respectively. The second specimen was taken at station 18 in July 1966 and measured 253 mm. in standard length and 306 mm. in total length and weighed 215.2 gms. the temperature was 32.0^{0}C., and the salinity was 7.0 ppt.

Megalops atlanticus Valenciennes. Tarpon

The tarpon is reportedly not as prevalent in Mississippi waters. particularly Mississippi Sound, as it was several years ago. Whether this in actuality is due to its absence or a decline in fishing for this species is debatable.

Two small tarpon were taken during the present study; both from land-locked ponds. The first specimen was collected in a seine haul at station 43 in November 1965. The fish measured 30 mm. in standard length, 37 mm. in total length and weighed 0.2 gm. The temperature and salinity were 20.8^0 C. and 21.5 ppt., respectively.

The possibility that the young fish reached the pond during the flood waters of Hurricane Betsy (September 1965) may be considered, since this presumably was the first period of high water in that vicinity of the island for some time. The odor of hydrogen sulfide gas was quite

evident following the disturbance of the pond bottom by seining procedures.

A second specimen was captured at station 1a in early August 1966. The fish measured 208 mm. in standard length, 255 mm. in total length, and weighed 172.0 gms. The temperature was 29.5°C., and the salinity was 1.7 ppt.

Family Clupeidae - Herrings

Alosa chrysochloris (Rafinesque). Skipjack herring

A single young fish measuring 25 mm. in a standard length, 31 mm. in total length, and weighing 0.3 gm. was collected at station 10 in September 1965. The temperature was 28.9°C., and the salinity was 29.0 ppt.

Dorosoma petenense (Günter). Threadfin herring

One *D. petenense* was taken in a trammel net at station 38 in November 1965. The fish measured 117 mm. in standard length and 145 mm. in total length and weighed 33.7 gms. The temperature and salinity were 18.9°C. and 17.1 ppt., respectively.

Harengula pensacolae Goode and Bean. Scaled sardine

Five specimens were collected. Two fish measuring 40 and 42 mm. in standard length and 49 and 52 mm. in total length and weighing 1.5 and 1.8 gms., respectively, were collected in August 1965 at station 10. Temperatures ranged from 30.6 to 31.0°C., and the salinity was 28.3 ppt. Three specimens ranging from 50 to 68 mm. in standard length, from 62 to 85 mm. in total length, and from 1.9 to 5.5 gms. in weight were taken in November 1965 at station 38. The temperature and salinity were 18.7°C. and 17.1 ppt., respectively.

Rivas (1950), in a revision of the genus, stated that as far as can be determined *Harengula pensacolae*" ... is the only species of *Harengula* inhabiting the Gulf Coast of the United States."

Family Engraulidae - Anchovies

Anchoa hepsetus (Linnaeus). Striped anchovy

Two hundred and fifty-three specimens were taken during the present study, and catch data are presented in table 2.

All fish were collected at salinities ranging from 17.1 to 27.6 ppt. Gunter and Hall (1963) reported that *A. hepsetus* is generally found at much higher salinities than *A. mitchilli*, the bay anchovy. Gunter and Hall (1963) also noted that one group of six fish was collected at a "salinity of 1.0, which is the lowest salinity at which the species has been reported." During the present study the mean salinity was 27.8 ppt.

Gunter (1945) reported males and females with developing gonads and well developed gonads in April and May, respectively, and noted that in June 1941 individuals ranging from 33 to 43 mm. in length were collected. Gunter and Hall (1963) collected the smallest fish (23-30 mm.) in October and January from the St. Lucie estuary in Florida.

TABLE 2 - Anchoa hepsetus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	230	22-51	27-62	0.2-1.5	30.6	28.4
Sept 22	10	1	78	87	4.5	28.9	29.0
Nov 17	38	7	46-55	55-63	1.4-1.6	18.7	17.1
1966							
June 9	10	2	38-52	46-62	1.2-1.7	26.0	23.0
Aug 2	10	13	30-58	37-68	0.6-1.5	30.0	24.5
						Mean Salinity	27.8

Water Temperatures are presented in Degrees Celsius.

Anchoa mitchilli (Valenciennes). Bay anchovy

Thirty-one bay anchovies were collected, and catch data are presented in table 3.

Gunter (1945) found this species to be abundant in Texas waters

and reported that it was more common in the bays than in the shallow Gulf.

During the present study fish were taken at salinities ranging from 7.0 to 29.0 ppt. The mean salinity was 27.3 ppt. Gunter (1945) found more fish at salinities less than 5.0 ppt. and remarked that this species is known to be euryhaline. Kilby (1955) reported specimens collected at salinities ranging from 6.2 to 37.6 ppt., and found anchovies to be more abundant in areas of high salinities at Cedar Key. Gunter and Hall (1965) collected 1,176 fish (16-88 mm.) at seine stations in the Caloosahatchee estuary in Florida at salinities ranging from 0.14 to 28.4 and noted that the majority of the specimens were taken at salinities less than 1.0. Gunter and Hall (1963) noted that small fish were taken at low, intermediate, and high salinities and concluded that salinity was a minor factor in determining the distribution of this species.

Gunter (1945) reported indications of an extended breeding season, probably from spring to fall. Reid (1954) collected a female in June with mature ovaries. Kilby (1955) found anchovies from 16 to 19 mm. in length in June, July, and October, and remarked that this indicated either two breeding seasons or an extended one. One specimen collected by the writer in September measured 22 mm. in total length.

TABLE 3 – Anchoa mitchilli

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Sept 22	10	29	18-32	22-45	0.1-0.3	28.2-28.7	29.0
Nov 17	38	1	56	67	1.7	18.9	17.1
1966							
July 23	17	1	48	57	1.5	31.0	7.5
July 30	18	1	73	86	2.1	31.8	7.0
						Mean Salinity	27.3

Water Temperatures are presented in Degrees Celsius.

Order Iniomi

Family Synodontidae - Lizardfishes

Synodus foetens (Linnaeus). Lizardfish

A total of five specimens ranging from 60 to 135 mm. in standard length and from 3.6 to 22.4 gms. in weight was taken during the present study, and catch data are presented in table 4. All specimens were collected at relatively high salinities. Kilby (1955) stated, "obviously the fish is not a marsh inhabitant."

Gunter (1945), Reid (1954), and Kilby (1955) reported indications of a spring spawning season for this species. There are also indications of summer and fall spawning periods (Springer and Woodburn, 1963; Gunter and Hall, 1963).

TABLE 4 – Synodus foetens

Date	Station	No. Of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	2	60-135	70-156	3.6-22.4	30.6	28.3
Oct 27	23	1	107	121	9.4	27.1	23.6
1966							
June 9	10	2	78-106	88-125	7.1-9.5	25.7	23.0
						Mean Salinity	25.2

Water Temperatures are presented in Degrees Celsius.

Order Cypriniformes

Family Ariidae - Marine catfishes

Galeichthys felis (Linnaeus). Hardhead catfish

Only fourteen specimens were collected, and catch data are presented in table 5. This euryhaline species was taken at salinities ranging from 17.1 to 29.0 ppt.

Gunter (1945) found a breeding season in Texas waters from June to July with the young being liberated in August. Reid (1954) reported breeding to be probably in May and June in the Cedar Key area. Very

small fish were collected in May from the Caloosahatchee in Florida, and at this time ripe and spent females were encountered as well (Gunter and Hall 1965).

Gunter (1947) remarked on various breeding habits in G. felis and also discussed certain aspects of ovarian eggs. Gunter (1945) noted the presence of a micropyle in ovarian eggs and described the long plugs of hyaline, non-functional eggs which were attached opposite the micropyle to the functional ovarian eggs. It was suggested (Gunter 1947) that the non-functional eggs may serve as food material for the male preceding the long non-feeding period during oral gestation.

Ward (1957) reported the spawning season in the Biloxi Bay, Mississippi area to be from the first week of May through the first week of August, and discussed at some length the reproduction and early embryology of this species.

TABLE 5 — Galeichthys felis

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Sept 22	10	10	110-122	133-145	21.0-32.0	28.4-28.9	29.0
Nov 17	38	1	174	208	99.9	18.9	17.1
1966							
Aug 26	34	3	55-118	70-145	3.2-27.2	30.8-31.7	19.0
						Mean Salinity	26.0

Water Temperatures are presented in Degrees Celsius.

Order Synentognathi

Family Belonidae - Neddlefishes

Strongylura marina (Walbaum). Needlefish

One *S. marina* was seined from the channel at station 10 in June 1966. The specimen measured 93 mm. in standard length and 99 mm. in total length and weighed 13.7 gms. The temperature was 25.1°C.

A second specimen was also collected by seining in August 1966. The fish measured 224 mm. in standard length and 243 mm. in total

length and weighed 17.0 gms. The temperature at the time of capture was 28.9^{0}C.

This species is considered to be euryhaline (Gunter 1942; Berry and Rivas 1962). The June specimen was taken from waters with a salinity of 23.0 ppt., and the specimen collected in August was taken at a salinity of 24.5 ppt.

Strongylura marina has often been recorded as *S. timucu* (Berry and Rivas 1962).

Family Hemiramphidae - halgbeaks

Hyporhamphus unifasciatus (Ranzani). Halfbeaks

One specimen measuring 161 mm. in standard length and 170 mm. in total length and weighing 17.1 gms. was encountered in the tidal channel at station 23 in June 1966. The temperature and salinity were 32.0^{0}C. and 27.0 ppt., respectively.

Schools of this species were observed on several occasions in the tidal channel at station 10. Seining proved to be unfruitful due to the swift, evasive manner of the creatures. Kilby (1955) states, "undoubtedly these fish are among those forms most successful at avoiding nets. They take flight at the slightest disturbance... ." The present specimen fortunately was captured by casting a six foot brail net from the channel's edge.

Order Cyprinodontiformes

Family Cyprinodontidae - Killifishes

Adinia xenica (Jordan and Gilbert). Diamond killifish

Two hundred and nine specimens were taken during the present study. Specimens ranged from 16 to 35 mm. in standard length and from 0.2 to 1.3 gms. in weight.

Gunter (1945) found this species most often at medium salinities

and noted its scarcity at high salinities and absence at the lowest salinities. Later Gunter (1950) took thirty-five specimens in Texas at salinities of 3.1 to 16.3 ppt. Kilby (1955) reported that *A. xenica* "prefers medium salinities between 15 and 25 ppt." Simpson and Gunter (1956) found this fish in Texas to be most abundant at medium and somewhat high salinities with some specimens being taken at hypersalinities during a period of drought on the coast. Catch data in table 6 show that 25.8 per cent of all specimens were from waters with salinities of 21.5 ppt. or higher, and 74.2 per cent were taken at salinities of 18.0 ppt. or lower. The mean salinity was 18.3 ppt.

Adenia xenica was encountered more often in landlocked areas than in tidal lagoons. Kilby (1955) noted that this species showed a tendency for avoidance of open waters and concentrated in inner pools at Cedar Key.

TABLE 6 — Adinia xenica

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Oct 12	16	1	31	38	0.5	26.5	23.0
Oct 27	23	55	16-32	19-37	0.2-0.4	27.1	16.5
Nov 11	39	1	28 28	33	0.6	21.0	21.5
Nov 11	42	4	16-29	20-35	0.4-0.7	19.0	22.5
1966							
June 15	16	48	25-35	30-42	0.6-0.8	28.9-31.5	24.8 & 26.9
June 15	18	18	24-31	29-38	0.5-0.6	31.5	13.3
June 17	2	16	26-35	31-43	0.5-0.8	31.5	5.6
July 23	17	4	21-28	25-33	0.2-0.6	31.0	7.5
July 25	19	41	26-34	32-41	1.3-0.5	29.1-30.0	15.1
July 25	20	11	27-31	33-38	0.8-1.2	30.4	15.1
July 27	1(B)	1	26	32	0.4	32.8	1.7
July 30	18	1	26	32	0.4	32.0	7.0
Aug 29	37	5	29-33	36-40	0.9-1.2	31.6-31.8	11.0
Sept 1	38	3	30-32	37-39	0.7-1.1	32.1-32.5	18.0
						Mean Salinity	18.3

Water Temperatures are presented in Degrees Celsius.

Cyprinodon variegatus Lacépède. Southern sheepshead killifish

A total of 4,532 specimens was collected, and this species was encountered during 75.4 per cent of the total collection periods. *Cyprinodon variegatus* was collected in habitats ranging from marshes to the open waters of lagoons and ponds. The number of this species represents 15.9 per cent of the total catch of all fishes.

Specimens ranged in size from 8 to 48 mm. in standard length and from 0.1 to 5.0 gms. in weight.

Cyprinodon variegatus was taken at temperatures ranging from 14.1°C. to 33.5°C. and salinities ranging from 0.6 ppt. to 29.0 ppt. Catch data in table 7 show that 52.5 per cent of all *C. variegatus* collected were from waters with salinities of 18.3 ppt. or more, and 47.5 per cent were from salinities of 17.1 ppt. or less. The mean salinity was 16.9 ppt.

Males and females composed 16.2 per cent and 83.8 per cent, respectively, of the total number of specimens.

TABLE 7 – Cyprinodon variegatus

Date	Station	No. of Specimens male	female	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965								
Aug 18	10		3	29-35	37-44	1.1-1.6	31.0	28.3
Oct 12	16	7	32	20-48	26-60	0.5-5.0	28.2-28.9	23.0
Oct 19	5	1	2	20-36	25-44	0.3-1.5	26.5	29.0
Oct 19	8		5	28-34	41-49	1.0-2.7	26.9	3.9
Oct 27	23	13	93	23-40	28-50	0.7-2.3	26.9	23.0
Oct 27	22	1	36	15-40	20-48	0.2-2.0	27.1	16.5
Nov 2	29		2	32-34	27-40	1.0-1.5	21.9	22.7
Nov 4	30	1	1	29-37	35-46	1.3-1.8	21.0	2.6
Nov 4	32	1	3	35-40	43-50	1.7-2.2	21.2	11.3
Nov 11	39		88	14-28	18-35	0.1-0.8	21.0	21.5
Nov 11	40	1	35	12-32	15-40	0.1-0.9	18.5	27-1
Nov 11	41		83	8-19	11-23	0.1-0.2	18.5	27.1
Nov 11	42	25	29	20-39	24-46	0.3-0.2	19.0	22.5
Nov 11	43	1	13	13-20	16-26	0.1-0.3	20.8	21.5
Nov 11	44		60	12-34	15-43	0.1-0.2	21.0	27.0
Nov 17	38	1	30	15-45	19-55	0.1-2.3	18.4	17.1
Nov 19	14		27	13-31	23-38	0.3-0.8	20.0-21.4	9.3
Nov 21	12		2	38-39	48	1.8-1.9	20.8	7.2
Nov 24	4		2	39-39	50-50	2.6-3.0	20.5	13.1
Dec 22	3		1	33	39	1.3	14.1	5.3

(TABLE 7 continued)

Date	Station	No. of Specimens male	female	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1966								
June 9	10	48	342	21-46	26-55	0.2-2.6	25.1-26.0	23.0
June 15	16	5	17	20-44	25-53	0.3-2.4	28.9-31.5	14.8-26.9
June 15	18	65	381	14-45	18-54	0.2-2.5	31.5	13.3
June 17	2	43	75	16-46	19-55	0.2-2.5	31.5	5.6
June 20	23	20	192	18-45	22-54	0.2-2.5	29.0-32.0	27.0
June 24	24	9	63	21-44	26-54	0.3-3.0	30.3	4.6
June 24	25	3	28	21-43	26-52	0.3-3.0	30.5	4.8
July 2	10	46	174	18-42	22-52	0.2-2.2	27.0-27.9	26.0
July 6	11	4		23-42	29-51	0.5-3.0	33.0	5.1
July 19	23	108	424	15-44	19-50	0.1-3.0	28.6-31.0	26.4
July 21	6	27	17	21-42	26-52	0.4-4.0	30.0	5.5
July 25	19	7	30	17-32	21-40	0.2-1.4	29.1-30.0	15.1
July 25	20	6	46	21-31	26-39	0.4-1.4	30.4	15.1
July 26	21	6	42	26-41	32-50	0.8-2.9	20.7-32.6	14.3
July 27	1 (A)	6	5	22-45	28-55	0.6-4.4	32.7	1.7
July 27	1 (B)	8	11	19-49	24-59	0.4-5.9	32.7	1.7
July 27	1 (c)	7	8	31-50	36-56	1.7-5.4	32.8	1.7
July 27	1 (D)	1	12	21-44	26-53	0.2-3.6	32.8	1.7
July 29	15		13	20-31	26-38	0.5-1.7	33.3-33.5	2.2
July 30	18	35	156	21-42	26-51	0.3-3.4	31.8-32.0	7.0
Aug 2	10	36	151	15-41	19-50	0.1-3.0	28.9-80.0	24.5
Aug 15	18	81	324	19-36	23-42	0.2-1.7	29.4-31.0	8.1
Aug 20	23	71	235	17-35	21-41	0.2-1.7	31.6-32.5	26.1
Aug 23	33	6	46	21-35	26-42	1.0-2.0	31.8-32.5	0.6
Aug 26	34	1	13	24-40	30-50	0.5-2.4	29.1-31.7	19.0
Aug 26	35	1	6	18-40	22-50	0.2-2.0	32.0	18.3
Aug 29	36	9	81	18-40	22-50	1.5-2.4	31.0-31.5	10.8
Aug 29	37	14	117	18-35	23-42	0.2-2.0	31.6-31.8	11.0
Sept 1	38		244	24-35	30-42	0.6-2.0	31.3-32.1	18.0
							Mean Salinity	16.9

Water Temperatures are presented in Degrees Celsius.

Fundulus grandis Baird and Girard. Gulf killifish

One hundred and forty-six specimens were taken, and catch data are presented in table 8. *Fundulus grandis* was not as abundant as *F. similis* in total catch and was taken only about one-half as many times. The specimens ranged from 32 to 106 mm. in standard length and from 0.9 to 45.0 gms. in weight. Fish were taken at temperatures ranging from 20.0 to 30.0°C.

Kilby (1955) noted that this species was not as abundant in open waters as in outer pools and water courses, and stated: "It appears... that *F. g. grandis* is more responsive to the type of habitat than to the salinity of its water, provided that the water is at least brackish and

not above 25 ppt. "Gunter (1945) noted that this species was more abundant at salinities less than 15.0 ppt., and found *F. grandis* in greatest abundance during summer and midwinter. During the present study *F. grandis* was found to be most abundant at low and high salinities and rather uncommon at moderate salinities. The mean salinity was 13.8 ppt.

According to Kilby (1955) there is a continuous breeding season at Bayport and Cedar Key.

TABLE 8 — Fundulus grandis

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	1	63	78	6.0	31.0	28.3
Oct 12	16	6	38-70	42-83	1.0-6.7	26.5-26.9	23.0
Oct 19	5	1	105	120	23.0	26.5	29.0
Nov 2	29	2	53-62	62-76	3.0-4.3	22.2	22.7
Nov 21	12	1	106	122	24.0	20.8	7.2
Nov 24	2	8	35-90	44-110	1.0-16.0	20.0	9.1
Nov 24	4	1	106	122	23.0	20.5	13.1
1966							
June 9	10	13	43-95	54-106	2.0-16.0	25.1-26.0	23.0
June 15	16	2	51-64	62-77	3.6-4.6	28.9	26.9
June 17	2	1	63	75	4.3	31.5	5.6
June 20	23	2	74-80	85-92	7.8-10.0	29.0	27.0
July 6	11	16	34-77	42,93	0.9-12.0	33.0	5.1
July 11	28	6	45-56	56-66	2.0-4.0	24.9-30.8	3.0
July 19	23	18	34-93	42-113	1.0-26.0	28.6-31.0	26.4
July 21	6	7	41-84	48-100	2.0-17.0	30.0	5.5
July 25	19	3	41-60	51-74	2.0-6.0	29.0	15.1
July 25	20	5	41-61	51-75	2.0-6.0	30.4	15.1
July 27	1(A)	5	39-46	47-56	1.5-2.6	32.7	1.7
July 27	1(C)	5	37-60	45-72	1.3-6.1	32.8	1.7
Aug 2	10	8	64-112	79-135	6.0-35.0	28.9-30.0	24.5
Aug 15	18	16	62-96	77-117	6.0-45.0	29.4-31.0	8.1
Aug-23	33	2	56-57	67-68	4.2-4.3	32.5	0.6
Aug 29	36	12	32-60	40-74	0.9-6.0	31.0-31.5	10.8
Aug 29	37	4	45-61	56-75	2.0-6.0	31.6-31.8	11.0
Sept 1	38	1	84	103	14.2	32.1	18.0
						Mean Salinity	13.8

Water Temperatures are presented in Degrees Celsius.

Fundulus pulvereus (Evermann). Bayou killifish

Eight specimens were taken, and catch data are given in table 9. The fish ranged from 35 to 45 mm. in standard length and from 1.1 to 2.1 gms. in weight. Temperatures ranged from 20.8 to 32.8°C., and salinities ranged from 1.7 to 12.1 ppt.

Evermann (1892), unaware of the sexual dimorphism exhibited by this species, described the females as *Zygonectes pulvereus* while considering the males to be *Zygonectes funduloides*. Gunter (1950) noted that *F. pulvereus* had been uncommonly reported in the literature since its description and remarked that the specimens he took from salt flat ponds were probably strays from freshwater.

Cook (1959) and Brown (1957) reported on the range of this species and its affinity for fresh and brackish water. Simpson and Gunter (1956) collected only sixty specimens at stations from the Rio Grande to the Sabine River, presumably finding *F. pulvereus* to be uncommon in that area. Simpson and Gunter (1956) presented a descriptive account concerning the characteristics of males and females and concluded that *F. pulvereus* spawns in the fall and winter and possibly other seasons as well.

TABLE 9 — Fundulus pulvereus

Date	Station	No. of Specimens male	female	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965								
Nov 19	13		1	39	46	1.2	20.8	12.1
1966								
June 17	1(A)	1		35	44	1.4	32.7	1.7
July 21	1(C)	2	2	36-44	43-52	1.1-2.0	32.8	1.7
July 27	6		1	38	45	1.3	30.0	5.5
July 27	2		1	45	53	2.1	31.5	5.6
							Mean Salinity	4.0

Water Temperatures are presented in Degrees Celsius.

Fundulus similis (Baird and Girard). Longnose killifish

A total of 3,782 specimens was obtained in 72.1 per cent of all collections. This species was taken in marshes as well as in open waters and constituted 13.2 per cent of the total catch. Specimens were collected at salinities ranging from 1.7 ppt. to 29.0 ppt. and temperatures ranging from 14.1° C. to 33.0° C.

Table 10 shows that 62.1 per cent of all collected specimens were taken at salinities of 18.0 ppt. and above, and 37.9 per cent were taken at salinities of 17.1 ppt. or less. Fish were taken at a mean salinity of 18.5 ppt.

All collected specimens were from 18 to 100 mm. in standard length and from 0.1 to 13.8 gms. in weight.

Fundulus similis was seen numerous times in large schools in water ranging from several inches to several feet in depth. Kilby (1955) states that he found large specimens of *F. similis* to be quite adept at avoiding capture. This could possibly account for the fact that only a few large specimens were taken during the present study even though many were observed.

TABLE 10 – Fundulus similis

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	31	20-98	25-117	0.1-13.8	29.3-31.0	28.3
Sept 22	10	4	19-29	25-36	0.2-0.5	28.7-28.9	29.0
Oct 12	16	81	19-80	25-95	0.1-8.4	26.5-26.9	23.0
Oct 19	5	21	18-55	22-68	0.1-2.7	28.5	29.0
Oct 19	8	28	25-52	31-64	0.7-3.6	26.9	3.9
Oct 27	23	25	30-58	37-71	0.8-3.2	26.9	23.0
Oct 27	22	2	24-25	29-31	0.2-0.3	27.1	16.5
Nov 2	29	10	24-68	31-82	0.2-4.6	21.9	22.7
Nov 4	30	11	19-56	24-71	0.1-3.4	21.0	2.6
Nov 4	31	17	19-63	24-75	0.1-4.6	21.1	2.1
Nov 4	32	7	18-38	23-47	0.1-1.3	21.2	11.3
Nov 11	39	2	33	40	0.7	21.0	21.5
Nov 17	38	14	22-49	26-59	0.1-1.6	18.7-18.9	17.1
Nov 19	13	5	36-44	63-74	0.5-3.1	20.8-21.4	12.1
Nov 21	12	5	24-29	65-73	0.1-3.4	20.8	7.2
Nov 24	2	1	63	76	4.0	20.0	9.1
Nov 24	4	5	25-65	30-80	0.4-5.3	20.5	13.1
Dec. 22	3	1	63	76	3.8	14.1	5.3
1966							
June 9	10	198	20-30	24-33	0.1-0.4	25.1-26.0	23.0
June 15	16	22	20-32	24-39	0.1-0.5	28.9	22.1-26.9
June 15	18	328	20-44	25-54	0.1-1.0	30.5-31.5	13.3
June 17	2	10	20-36	24-42	0.1-0.5	31.5	5.6
June 20	23	289	25-39	30-47	0.1-0.8	29.0-32.0	27.0
June 24	24	11	28-33	36-41	0.4-0.5	30.3-30.5	4.6
June 2	10	426	30-60	36-75	0.5-5.4	27.0-28.0	26.0
July 4	26	8	27-87	33-105	0.2-12.1	29.1-31.3	13.1
July 4	27	4	38-88	46-106	1.5-12.0	31.8	12.4
July 6	11	10	30-88	36-104	0.6-13.3	33.0	5.1

(Table 10 continued)

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm)	Water Temperature	Salinity (ppt.)
July 11	28	8	22-100	28-119	0.2-30.9	29.4-30.8	3.0
July 19	23	460	30-46	36-56	0.6-2.1	28.6-31.0	26.4
July 21	6	4	39-43	47-50	1.5-1.7	30.0	5.5
July 25	19	61	30-42	36-52	0.6-1.2	29.1-30.0	15.1
July 25	20	40	25-42	30-52	0.4-1.5	30.4	15.1
July 26	21	22	30-41	36-50	0.6-1.6	30.7-32.6	14.3
July 27	1(A)	1	43	56	2.7	32.7	1.7
July 27	1 (B)	1	46	56	2.9	32.7	1.7
July 27	1(C)	4	28-34	35-43	0.5-0.9	32.8	1.7
July 27	1(D)	2	32-38	39-47	0.7-1.3	32.8	1.7
July 30	18	382	30-51	36-63	0.5-2.7	31.8-32.0	7.0
Aug 2	10	276	31-53	37-64	0.7-3.0	28.9-30.0	24.5
Aug 15	18	375	32-56	38-68	0.7-3.3	29.4-31.0	8.1
Aug 20	23	502	22-56	26-67	0.2-3.3	31.6-32.5	26.1
Aug 26	34	8	49-76	60-91	2.8-10.3	29.1-31.0	19.0
Aug 26	35	24	19-66	23-79	0.1-7.2	31.7-32.0	18.3
Aug 29	36	15	20-41	25-51	0.1-1.4	31.0-31.5	10.8
Aug 29	37	19	30-42	36-52	0.6-1.5	31.6-31.8	11.0
Sept 1	38	2	39-42	49-51	1.4-1.6	32.5	18.0
						Mean Salinity	18.5

Water Temperatures are presented in Degrees Celsius.

Lucania parva (Baird and Girard). Rainwater killifish

One thousand nine hundred and ninety-six specimens were collected. This constitutes 6.1 per cent of the total catch.

Catch data in table 11 show that specimens ranged from 10 to 44 mm. in standard length and from o.1 to 1.0 gms. in weight. Temperatures ranged from 18.4 to 33.5^{0}C.

Gunter (1945) found *L. parva* most abundant at salinities ranging between 10.0 to 15.0 ppt. Kilby (1955) reported that 81.0 per cent of all specimens taken were from salinities of 10.0 ppt. or less. Simpson and Gunter (1956) noted that 39.4 per cent of the catch of *L. parva* was collected from salinities below 10.0 ppt. with the majority of specimens being taken at salinities from 18.4 to 48.2 ppt. During the present study 69.2 per cent of all specimens were taken at salinities of of 21.5 ppt. and above, and 30.8 per cent of all specimens were taken at salinities of 19.0 ppt. or less.

Gunter (1945) said the presence of small fish at practically all seasons of the year indicated a long breeding season in Texas.

TABLE 11 – Lucania parva

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Oct 22	9(A)	10	21-25	32-38	0.1-0.4	28.6	Fresh
Oct 22	9(B)	18	15-33	19-41	0.1-0.4	28.7	Fresh
Nov 11	39	10	21-36	26-44	0.1-0.5	18.5	21.5
Nov 11	40	12	21-36	26-44	0.1-0.5	18.5	21.5
Nov 11	43	238	12-35	15-43	0.1-0.4	20.8	21.5
Nov 11	44	583	15-33	19-40	0.1-0.8	21.0	22.5
Nov 11	45	536	10-40	12-48	0.1-0.5	20.5	27.0
Nov 17	38	38	27-44	33-52	0.5-1.4	18.4-18.9	17.1
Nov 19	13	4	30-32	36-40	0.7-0.8	20.0	12.1
Nov 19	14	74	18-34	22-40	0.1-0.4	20.8-21.4	9.3
1966							
June 24	24	18	21-32	24-37	0.2-0.8	30.3	4.6
June 24	25	17	24-31	27-36	0.3-0.7	30.5	4.8
July 23	17	87	20-34	25-41	0.2-0.8	29.2-21.0	7.5
July 25	19	7	21-31	24-36	0.2-0.8	29.1-30.0	15.1
July 27	1(A)	6	31-37	39-46	0.9-1.5	32.7	1.7
July 27	1(B)	10	28-38	35-48	0.8-1.8	32.7	1.7
July 27	1(C)	2	30-34	38-43	0.8-0.9	32.8	1.7
July 27	1(D)	9	25-33	31-41	0.3-0.9	32.8	1.7
July 29	15	59	20-31	24-38	0.1-0.7	33.3-33.5	2.2
July 30	18	21	15-34	20-41	0.1-0.8	31.8-32.0	7.0
Aug 23	33	50	19-33	22-40	0.2-0.9	31.8-32.5	0.6
Aug 16	26	103	26-34	30-41	0.4-0.8	29.1-31.7	19.0
Aug 16	26	42	18-35	20-42	0.1-1.0	30.8-32.0	18.3
						Mean Salinity	12.2

Water Temperatures are presented in Degrees Celsius.

Family Poeciliidae - Livebearers

Gambusia affinis (Baird and Girard). Mosquitofish

Four thousand five hundred and ninety-two mosquitofish were collected during the present study. The majority of specimens was collected near banks of heavily vegetated, shallow waters. *Gambusia affinis* was taken in 49.2 per cent of all collections and constituted 16.1 per cent of the total catch.

Specimens ranged from 10 to 35 mm. in standard length and from 0.1 to 1.4 gms. in weight. Males and females composed 3.4 per cent and 96.6 per cent, respectively, of the total number of specimens.

Fish were taken at temperatures ranging from 14.1 to 33.5^{0}C.,

and were found in waters with salinities ranging from fresh to 29.0 ppt. From catch data shown in table 12, it was determined that 71.4 per cent of the specimens were taken at salinities of 21.5 ppt. or higher, and 28.6 per cent were found at salinities of 13.3 or lower. Kilby (1955) stated that *G. affinis* can tolerate salinities as great as 22.0 ppt. During the present study a single specimen was taken from an isolated drainage ditch in which the salinity of the water was 29.0 ppt.

TABLE 12 – Gambusia affinis

Date	Station	No. of Specimens male	No. of Specimens female	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965								
Oct 19	5		1	27	34	0.4	26.5	29.0
Oct 22	9(A)		14	17-31	21-37	0.1-0.3	28.6	Fresh
Oct 22	9(B)		17	19-31	24-37	0.1-0.4	28.7	Fresh
Nov 2	29		7	19-32	24-38	0.1-0.4	21.9-22.2	22.7
Nov 11	39	6	450	14-33	18-41	0.1-0.6	21.0	21.5
Nov 11	40	21	323	10-28	13-34	0.1-0.2	18.5	27.1
Nov 11	41	5	51	12-20	16-26	0.1-0.1	18.5	27.1
Nov 11	42		2	19	24	0.1	19.0	22.5
Dec 22	3		1	24	29	0.2	14.1	5.3
1966								
June 6	10	7	369	10-32	12-39	0.1-0.7	25.1-26.0	23.0
June 15	18	10	351	14-32	16-39	0.5-0.7	31.5	13.3
June 20	23	11	285	10-33	12-40	0.1-0.7	29.0-31.8	27.0
June 24	25		6	22-29	25-35	0.1-0.5	30.5	4.8
July 2	10	19	488	10-32	12-39	0.1-0.6	27.0-27.9	26.0
July 4	16		30	11-32	20-39	0.1-0.7	29.1-31.3	13.1
July 4	27	1	22	13-30	16-38	0.1-0.5	31.7-31.8	12.4
July 6	11		3	27-35	39-48	0.5-1.4	33.0	5.1
July 11	28		9	12-15	15-19	0.1-0.1	29.4-30.8	3.0
July 19	23	14	470	11-32	13-40	0.1-0.6	28.6-31.0	26.4
July 21	6		8	15-33	18-41	0.2-0.9	30.0	5.5
July 23	17	1	14	16-29	20-35	0.1-0.6	29.2	7.5
July 27	1(C)		2	18-23	24-31	0.1-0.5	32.8	1.7
July 27	1(D)		2	27-28	35-36	0.5-0.6	32.8	1.7
July 29	15	1	16	18-28	24-35	0.1-0.6	33.3-33.5	2.2
July 30	18	13	314	16-29	20-35	0.1-0.5	31.8-32.0	7.0
Aug 2	10	19	290	10-32	13-39	0.1-0.6	28.9-30.0	24.5
Aug 15	18	11	401	11-30	14-37	0.1-0.5	29.4-31.0	8.1
Aug 20	23	15	294	12-29	15-36	0.1-0.5	31.6-32.5	26.1
Aug 23	33		72	22-32	27-38	0.2-0.8	32.5	0.6
Aug 29	36	3	23	12-27	15-32	0.1-0.3	31.0-31.5	10.8
							Mean Salinity	16.9

Water Temperatures are presented in Degrees Celsius.

Poecilia latipinna (LeSueur). Sailfin molly

Six thousand seven hundred and eighty-two specimens were collected. *Poecilia latipinna* was the most abundant species taken during the

present study, representing 21.3 per cent of the total catch. Mollies were taken in 75.4 per cent of all collections and were dominant in numbers in several collections. Table 13 shows that 92.8 per cent of the specimens were females, and 7.2 per cent were males.

Poecilia latipinna was found to be most abundant near densely vegetated marshes which bordered tidal lagoons. Numerous specimens were also taken in small ponds; hundreds often being taken in a single seine haul.

Specimens ranged from 9 to 59 mm. in standard length and from 0.1 to 8.0 gms. in weight.

Table 13 shows that *P. latipinna* was taken at temperatures ranging from 14.1 to 33.5°C. and salinities ranging from 0.6 to 29.0 ppt. Kilby (1955) states that "salinities appear to have no determinable effect on distribution."

TABLE 13 — Poecilia latipinna

Date	Station	Specimens male	Specimens female	No. of Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965								
Oct 12	16		11	31-47	38-56	1.0-2.5	26.5-26.9	20.0-23.0
Oct 19	5		6	24-32	30-38	0.4-0.7	26.5-26.9	29.0
Oct.27	22		1	22	28	0.4	27.1	16.5
Nov 2	29		1	33	39	0.9	21.7	22.7
Nov 4	30		7	30-45	38-57	1.3-3.0	21.0	2.6
Nov 4	31		4	36-46	42-57	1.6-3.0	21.1	2.1
Nov 4	32	3	20	22-42	28-52	0.7-2.5	21.2	11.3
Nov 11	39	1	272	15-47	19-57	0.1-2.8	21.0	21.6
Nov 11	40		161	12-39	17-48	0.1-1.8	18.5	27.1
Nov 11	41		18	17-34	21-42	0.2-1.3	18.5	27.1
Nov 11	42	4	218	9-50	12-63	0.1-2.4	19.0	22.5
Nov 11	43	4	176	9-37	13-47	0.1-1.7	20.8	21.5
Nov 11	44		435	13-35	17-43	0.1-1.5	21.0	27.0
Nov 11	45	1	9	13-26	16-31	0.1-0.5	20.5	22.5
Nov 17	38		8	25-47	32-58	0.6-2.7	18.7	17.1
Nov 19	14	1	15	24-52	29-65	0.4-2.5	20.8-21.4	9.3
Nov 21	12	3	3	40-47	52-61	1.8-2.2	20.8	7.2
Nov 24	4	2	4	43-49	55-63	0.2-3.4	20.5	13.1
Dec. 22	3	3	18	35-57	44-69	1.3-2.6	14.1	5.3
1966								
June 9	10	14	450	18-39	23-47	0.2-2.1	25.1-26.0	23.0
June 15	16	3	7	23-42	33-50	0.3-2.0	28.9-31.2	26.9
June 15	18	17	531	23-43	30-51	0.5-2.2	31.5	13.3

(Table 13 continued)

Date	Station	Specimens male	Specimens female	No. of Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
June 17	2	3	4	22-43	28-51	0.3-2.0	31.5	5.6
June 20	23	40	557	19-44	25-53	0.2-2.3	29.0-32.0	27.0
June 24	24	6	57	21-42	26-51	0.7-2.3	30.5	4.6
June 24	25	3	139	21-41	25-49	1.0-2.2	30.3	4.8
July 2	10	38	614	13-57	16-73	0.1-7.0	27.0-27.9	26.0
July 6	11	1	7	29-57	38-73	0.8-6.0	33.0	5.1
July 11	28	7	28	23-43	29-53	0.7-2.6	29.4-30.8	3.0
July 19	23	44	120	19-43	23-53	1.0-2.6	28.6-31.0	26.4
July 21	6	4	106	24-59	30-78	0.5-8.0	30.0	5.5
July 23	17	2	32	19-46	23-57	0.2-3.4	29.2-31.0	7.5
July 25	19	2	31	19-32	23-40	0.5-1.5	29.1-30.0	15.1
July 25	20	7	42	21-32	26-40	0.6-1.6	30.4	15.1
July 26	21	8	65	25-42	30-51	1.0-2.6	30.7-32.6	14.3
July 27	1(A)	1	25	24-47	31-61	0.5-2.5	32.7	1.7
July 27	1(B)	3	75	23-46	29-56	0.6-3.1	32.7	1.7
July 27	1(C)	1	16	25-43	32-54	0.4-2.6	32.8	1.7
July 27	1(D)	2	21	21-32	27-40	0.2-1.0	32.8	1.7
July 29	15	1	33	21-51	26-64	0.2-2.7	33.3-33.5	2.2
July 30	18	56	487	18-54	22-68	0.3-4.0	31.8-32.0	7.0
Aug 2	10	50	458	18-51	22-62	0.3-3.7	28.9-30.0	24.5
Aug 15	18	82	393	15-41	19-50	1.0-2.4	29.4-31.0	8.1
Aug 20	23	45	221	21-41	25-50	0.7-2.5	31.6-32.5	26.1
Aug 23	33	7	288	10-48	12-59	0.1-4.0	31.8-32.5	0.6
Aug 26	35	5	11	18-38	22-47	0.3-2.0	29.1-32.0	18.3
Aug 29	36	4	37	19-42	22-52	0.4-2.5	31.0-31.5	10.8
Aug 29	37	10	45	18-34	22-42	0.2-1.6	31.6-31.8	11.0
Sept 1	38	1	6	25-39	31-51	0.2-1.2	31.3-32.1	18.0
							Mean Salinity	14.6

Water Temperatures are presented in Degrees Celsius.

Order Gasterosteiformes

Family Syngnathidae - Pipefishes and Seahorses

Syngnathus louisianae Günther. Chain pipefish

Nine specimens were taken, and catch data are shown in table 14. Specimens ranged from 55 to 167 mm. in standard length and from 0.4 to 2.8 gms. in weight. All fish were taken at temperatures and salinities ranging from 25.1 to 30.6°C. and from 23.0 to 28.3 ppt., respectively.

Herald (1942, *fide* Reid, 1954) gave the range of this species as

extending from Maryland to Aransas Bay, Texas. Reports seem to indicate that the fish is not at all common throughout much of its range. Gunter (1945) collected only four specimens, all from Aransas Bay. Reid (1954) reported thirteen fish and noted that it "is relatively uncommon in the shallow waters about Cedar Key." Kilby (1955) took only two *S. louisianae* at Cedar Key; a point which tends to corroborate Reid's (1954) observation concerning this species.

TABLE 14 – Syngnathus louisianae

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	1	123	128	2.1	30.6	28.3
1966							
June 9	10	7	55-159	58-165	0.4-2.2	25.1-26.0	23.0
Aug 2	10	1	167	172	2.8	27.4	24.5
						Mean Salinity	24.8

Water Temperatures are presented in Degrees Celsius.

Syngnathus scovelli (Evermann and Kendall). Gulf pipefish

A seine haul in June 1966 through submerged vegetation yielded a single specimen of *S. scovelli*. The fish measured 78 mm. in standard length and 82 mm. in total length and weighed 0.5 gms. The temperature and salinity were 25.7°C. and 23.0 ppt., respectively.

A second specimen was collected in July 1966. The measurements were 113 mm. in standard length and 118 mm. in total length and the fish weighed 1.1 gms. The temperature was 31.0°C., and the salinity was 7.5 ppt.

Gunter (1945) found this species to be the most common pipefish of the Texas coast; furthermore, he reported that egg-carrying males were taken only in June, August, and November. Reid (1954) reported 637 *S. scovelli* from Cedar Key and noted indications of a continuous breeding season. Kilby (1955) recorded this species from the Gulf beach and in the shallow open Gulf at Cedar Key and from the Gulf beach or in nearby waters at Bayport; however, this species was not encountered in the interior of the marshes or in the fresh water streams.

Syngnathus scovelli has been reported to be the most common pipefish of the shores of the South Atlantic and the Gulf of Mexico (Gunter and Hall 1963).

Gunter (1942) reported this species from fresh water in Florida, and Whatley (1962) collected numerous *S. scovelli* from a fresh water lake, Lake Saint John, in Louisiana. This was the greatest fresh water penetration, some three hundred miles from the Gulf of Mexico, recorded and represented the first account of a breeding population inhabiting fresh water.

Order Perciformes

Family Serranidae - Sea basses

Centropristes philadelphicus (Linnaeus). Rock sea bass

Two specimens were obtained during the present study. One fish was taken in November 1965 from station 12. The specimen measured 69 mm. in standard length and 83 mm. in total length and weighed 7.4 gms. The temperature and salinity at the time of capture were 18.9^{0}C. and 7.2 ppt., respectively.

A small specimen was collected in September 1966 from station 38. It measured 26 mm. in standard length and 33 mm. in total length and weighed 0.3 gm. The temperature was 32.1^{0}C., and the salinity was 18.0 ppt.

Family Carangidae - Jacks and Pompanos

Caranx crysos (Mitchill). Blue runner

One specimen was taken in a trammel net in July 1966. The specimen measured 227 mm. in fork length and 260 mm. in total length and weighed 221.0 gms. The temperature and salinity were 28.0^{0}C. and 26.0 ppt., respectively.

Nichols (1939) presented information concerning meristics and the distribution of this species. McKenny *et al.* (1958) devoted a major

portion of their study to the early development of this species and reported that spawning might be continuous with a higher activity during the summer. Berry (1959) reported that spawning probably occurs from early April to early September.

Caranx hippos (Linnaeus). Jack crevalle

One *C. hippos* was captured in a trammel net at station 10 in June 1966. The temperature and salinity were 25.7^{0}C. and 23.0 ppt., respectively. The specimen measured 114 mm. in fork length and 135 mm. in total length and weighed 36.6 gms.

Gunter (1945) collected small fish (30 to 42 mm. in length) in June on the Gulf beach and in August found specimens ranging from 36 to 59 mm. in length.

An estimated spawning season for this species on the south-eastern Atlantic coast is from early March to early September; however, the actual place of spawning is unknown (Berry 1959).

Caranx latus Agassiz. Horse-eye jack

Five specimens were taken during the present study by seining. Four fish were collected in November 1965 from the channel at station 29, and a single fish was captured in November 1965 at station 13. The station 29 specimens ranged from 57 to 72 mm. in fork length, from 66 to 80 mm. in total length, and from 5.0 to 7.9 gms. in weight. The temperature and salinity were 22.2^{0}C. and 22.7 ppt., respectively. The specimen from station 13 measured 55 mm. in fork length and 63 mm. in total length and weighed 4.2 gms. The temperature was 20.0^0 C, and the salinity was 12.1 ppt.

An estimated spawning season for this species is thought to range from mid-March to mid-July (Berry 1959).

Chloroscombrus chrysurus (Linnaeus). Bumper

One bumper was taken in a trammel net in mid-November 1965 at station 14. The fish measured 75 mm. in fork length and 91 mm. in total length and weighed 7.0 gms. The temperature and salinity at the

time of capture were 20.8° C. and 9.3 ppt.

Smith (1907, *fide* Reid, 1954) and Longley and Hildebrand (1941) reported this species swimming with jellyfishes, and Reid (1954) gave a similar account. In November 1965 the writer observed several small fish swimming with *Aurellia aurita* in Mississippi Sound only a short distance from the entrance to the tidal channel which connects station 23 with Mississippi Sound. A dip net was employed, and after several attempts both the jellyfish and a number of small *C. chrysurus* were captured.

Oligoplites saurus (Block and Schneider). Leather jacket

A total of fourteen fish was taken during the present study. Two specimens with fork lengths of 38 and 59 mm. and total lengths of 42 and 67 mm. were seined in August 1965. The fish weighed o.6 and 1.6 gms., respectively. The temperature was 30.6° C., and the salinity was 28.3 ppt.

Twelve specimens were collected in July 1966. The fish ranged from 35 to 59 mm. in fork length, from 41 to 67 mm. in total length, and from 0.4 to 1.8 gms. in weight. During the collecting period temperatures ranged from 27.4 to 28.0° C., and the salinity was 26.0 ppt.

Kilby (1955) found indications of an extended breeding season at Cedar Key of at least four months; however, no conclusions were drawn as to the exact time of the season.

Family Leiognathidae - Mojarras

Eucinostomus argeneteus Baird and Girard. Spotfin mojarra

Eighty-three specimens were collected, and catch data are presented in table 15. *Eucinostomus argenteus* was taken from tidal channels, a drainage ditch, and two landlocked lagoons. The fish ranged from 18 to 52 mm. in standard length and from 0.3 to 4.7 gms. in weight. Temperatures ranged from 18.9 to 31.0° C.

Kilby (1955) very seldom found fish larger than 50 mm. in length; therefore, indications were that only the young were inhabitants of the

marshes and inshore waters. Gunter and Hall (1965) collected several specimens ranging from 26 to 109 mm. in length inside the Caloosahatchee estuary. *Eucinostomus argenteus* was recorded from fresh water at Homosassa Springs, Florida ((Herald and Strickland 1948). During the present study specimens were taken at salinities ranging from 9.3 to 29.9 ppt.

Reid (1954) and Kilby (1955) noted that *E. argenteus* and *E. gula* are ecologically distinct. Kilby (1955) found *E. argenteus* in the marsh at Cedar Key and Bayport, while *E. gula* was taken in "waters furthest from the mainland. "*Eucinostomus gula* was not encountered during the present study.

TABLE 15 — Eucinostomus argenteus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug. 18	10	70	19-58	25-74	0.3-4.7	29.3-31.0	28.3
Sept 22	10	7	18-56	23-72	0.3-4.6	28.2	29.0
Oct 12	16	1	40	53	1.4	26.5	23.0
Oct 19	5	1	43	54	1.3	26.5	29.0
Nov 17	38	3	21-27	27-35	0.3-0.5	18.9	17.1
Nov 19	13	1	23	30	0.5	20.0	9.3
						Mean Salinity	25.5

Water Temperatures are presented in Degrees Celsius.

Family Pomadasyidae - Grunts

Orthopristis chrysopterus (Linnaeus). Pigfish

Nine specimens collected in June 1966 from station 10 represent the total number of pigfish taken during the present study. The fish ranged from 22 to 34 mm. in standard length, from 27 to 40 mm. in total length, and from 0.4 to 0.9 gm. in weight. During the period of collecting the temperature ranged from 25.1 to 26.0^{0}C., and the salinity was 23.0 ppt.

Gunter (1945) reported a spring spawning season in Texas. Reid (1954) and Springer and Woodburn (1960) reported that a spring spawning season was indicated for this species in Florida. The size of the specimens taken by the writer suggested a spring spawning period for those

individuals.

Family Sciaenidae - Drums

Bairdiella chrysura (Lacépède). Silver perch

Two hundred and thirty-seven fish were taken during one collecting period in June 1966 at station 10. *Bairdiella chrysura* was not encountered at any other time. Specimens ranged in length from 11 to 40 mm. in standard length, from 14 to 48 mm. in total length, and from 0.2 gm. to 1.4 gms. in weight. The temperature ranged from 25.1 to 26.0°C., and salinity was 23.0 ppt.

Gunter (1938) reported that fish were in breeding condition from April through June in Louisiana, and according to Gunter (1945) this species spawns during spring in the waters of the Texas coastal lagoons. Kilby (1955) found indications of a breeding season in spring and summer for the Cedar Key and Bayport areas, and Reid (1954) also reported that apparently spawning occurs in early spring and summer. Gunter and Hall (1963) collected the smallest fish in May. During the present study 81.0 per cent of the June specimens measured 24 mm. or less in total length. These fish as well as a 48 mm. specimen were apparently spawned in the spring.

Cynoscion nebulosus (Cuvier). Spotted Squeteague

Fifty-eight specimens were collected, and catch data are given in catch table 16. Specimens ranged from 18 to 154 mm. in standard length and from 0.1 to 70.8 gms. in weight. The largest fish, 183 mm. in total length, was captured in a trammel net, with all other specimens being taken in seines.

Temperatures ranged from 21.9 to 31.0°C., and salinities ranged from 7.5 to 28.3 ppt. The mean salinity was 19.6 ppt.

Juveniles were taken on several occasions during the summer from several stations and were collected near shore in vegetated areas. According to Guest and Gunter (1958) there appears to be a general agreement that young specks, larval through juvenile stages, develop in vegetated, protected areas of inland waters.

Pearson (1929) reported a spawning season in Texas waters as being between fall (October) and spring, with the peak occurring in April and May. Reid (1954) suggested an extended summer and fall breeding season. Guest and Gunter (1958) noted that "spawning may occur in the deeper parts of the bay...or in the shallow grass beds..."

TABLE 16 – Cynoscion nebulosus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	4	19-48	23-59	0.8-1.5	31.0	28.3
Nov 2	29	1	154	183	70.8	21.9	22.7
1966							
June 9	10	10	18-27	22-35	0.1-2.6	25.1-26.0	23.0
July 2	10	14	34-40	43-50	0.7-1.0	27.0-27.9	26.0
July 23	17	14	43-66	54-82	1.2-4.3	29.2-31.0	7.5
Aug 2	10	11	31-62	39-76	0.6-3.8	29.6-30.0	24.5
Aug 15	18	4	44-67	54-82	1.3-4.3	31.0	8.1
						Mean Salinity	19.6

Water Temperatures are presented in Degrees Celsius.

Larimus fasciatus Holbrook. Banded croaker

A total of seven specimens was collected. One specimen measuring 122 mm. in standard length and 150 mm. in total length and weighing 59.4 gms. was seined in August 1966 at station 34. The temperature and salinity were 32.0°C. and 19.0 ppt., respectively. In September 1966 six fish were captured in a trammel net at station 38. The September specimens ranged from 152 to 229 mm. in standard length, from 195 to 271 mm. in total length, and from 32.1 to 32.5 gms. in weight. Temperatures recorded during the collecting period were 32.1 and 32.5°C., and the salinity was 18.0 ppt.

Gunter (1945) found *L. fasciatus* to be much more common in Louisiana than in Texas. Spawning appears to occur from May to October in Texas waters (Miller 1965).

Leiostomus xanthurus Lacépède. Spot

Forty-three spot were taken, and catch data are presented in table 17. Thirty-seven specimens were collected in seines, and six were captured in trammel nets.

Kilby (1955) found this species at Bayport and Cedar Key to be "particularly partial to outer pools and was found rarely, or not at all, in the other habitats, with the exception of water courses." During the present study the majority of specimens were taken from tidal lagoons and their respective channels or water courses.

Specimens ranged from 23 to 195 mm. in standard length and from 1.0 to 180.0 gms. in weight. Reid (1954) reported that spawning apparently occurs in winter and early spring in the area of Cedar Key. Gunter (1945) reported small fish (23 to 93 mm. in length) in April from Texas waters. Kilby (1955) found individuals which were less than 20 mm. in length during January, February, March, and May at Cedar Key, and noted that the January young reach between 70 and 85 mm. in length in June. Gunter and Hall (1963) took a 41 mm. specimen in May. During the present study young (28 to 81 mm. in total length) were encountered during June and July.

Dawson (1958) reported on the life history of *L. xanthurus*. Pearson (1929) found only three spot above 250 mm. in length from Texas waters and was led to believe that this species dies after spawning. Gunter (1945) reported 15 spot ranging from 255 to 282 mm. long and stated that even though he obtained a greater number of the larger members than did Pearson, "...it is still small and tends to corroborate, rather than invalidate his theory." During the present study two specimens, 240 and 242 mm. in total length, were taken in July.

TABLE 17 – Leiostomus xanthurus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1966							
June 9	10	16	23-66	28-81	1.0-6.1	25.1-26.0	23.0
June 15	18	8	33-43	42-53	2.0-3.4	31.5	13.3
June 17	2	7	33-43	42-53	2.0-2.5	31.5	5.6
June 20	23	1	44	54	2.6	31.8	27.0
July 2	10	6	83-195	109-242	21.0-180.0	27.0-28.0	26.0
July 6	11	1	56	70	4.3	33.0	5.1
Sept 1	38	4	127-165	172-210	56-0-121.0	32.5	18.0
						Mean Salinity	18.0

Water Temperatures are presented in Degrees Celsius.

Menticirrhus americanus (Linnaeus). Southern whiting

Eleven *M. americanus* were taken during the present study. Table 18 shows that: specimens were taken at temperatures ranging from 21.7 to 32.5^{0}C. Gunter and Hall (1963) found the low salinity limit for *M. americanus* to be 12.7 ppt. and noted that this species "does not venture into low salinity waters." During the present study three specimens were taken at a salinity of 8.1 ppt.

The smallest specimen, 33 mm. in total length, was collected in November 1965. Gunter and Hall (1963) noted that the smallest fish (23 - 24 mm.) caught during their study were taken in November.

Gunter (1945) reported that the spawning season must be long, since he collected a fish with large roe in November 1941 and another with developing roe in March 1942. Reid (1954) reported an apparent spawning season from early spring through the summer in the Cedar Key area. Gunter (1945) and Miller (1965) are in agreement that the young mature in the Gulf.

TABLE 18 — Menticirrhus americanus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Nov 2	29	1	21	33	1.3	21.7	8.1
1966							
Aug 15	18	3	74-95	95-116	4.0-6.8	31.0	22.7
Aug 20	23	7	57-102	74-131	2.1-7.4	31.6-32.5	26.1
						Mean Salinity	23.5

Water Temperatures are presented in Degrees Celsius.

Menticirrhus littoralis (Holbrook). Silver whiting

Six specimens collected in July 1966 represent the total catch of *M. littoralis.* Fish ranged from 51 to 62 mm. in standard length, from 65 to 88 mm. in total length, and from 1.9 to 3.8 gms. in weight. The temperature of the water at the time of capture was 29.2^{0}C.

Gunter (1945) noted that this species seemed to prefer higher salinities than did *M. americanus* and was rarely taken at salinities be-

low 25.0 ppt. Gunter and Hall (1965) noted a salinity of 34.4 to 37.5 ppt. for their specimens from the Caloosahatchee in Florida. Interestingly enough during the present study all specimens were taken at a salinity of 7.4 ppt.

Menticirrhus littoralis was found to be less abundant than *M. americanus* in Texas waters (Gunter 1945; Miller, 1965). In contrast Springer and Woodburn (1960) found the fish to be "much more abundant" than *M. americanus* in the Tampa Bay area. Gunter and Hall (1965) took the two species in about equal numbers off the Caloosahatchee. Reid (1954) did not report this species from Cedar Key, and Kilby (1955) did not take *M. littoralis* at either Cedar Key or Bayport.

Gunter and Hall (1965) found indications of a rather long spawning season due to the appearance of small fish (22-27 mm.) from May to October.

Micropogon undulatus (Linnaeus). Croaker

Thirteen croakers were taken during the present study. All specimens were captured in a trammel net, and catch data are given in table 19.

Reid (1954) and Kilby (1955) did not take *M. undulatus,* and Reid (1954) discussed the zoogeographical factors affecting the distribution of this species. Pearson (1929), Gunter (1945), Suttkus (1955), and Springer and Woodburn (1960) have made contributions to the life history of *M. undulatus* on the Gulf Coast.

A parasitic isopod identified as *Livoneca ovalis* was attached to the snout of a July specimen.

TABLE 19 — Micropogon undulatus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1966							
July 2	10	5	181-200	221-245	116.0-159.7	27.4-28.0	26.0
July 23	17	3	174-190	215-234	98.3-123.0	31.0	7.5
Sept 1	38	5	191-221	235-261	120.0-216.0	32.1	18.0
						Mean Salinity	18.7

Water Temperatures are presented in Degrees Celsius.

Sciaenops ocellatus (Linnaeus). Redfish

Two redfish were taken in trammel nets. The first specimen was collected in November 1965 and the second in September 1966. The November specimen measured 339 mm. in standard length and 392 mm. in total length and weighed 412.8 gms., and was taken from waters with a temperature and salinity of 18.7° C. and 17.1 ppt., respectively. The specimen collected in September measured 235 mm. in standard length and 293 mm. in total length and weighed 249.6 gms. The temperature was 32.5° C., and the salinity was 18.0 ppt.

Sciaenops ocellatus is taken in respectable numbers by fishermen during summer, fall, and winter in both Mississippi Sound and the island passes. During early fall redfish are numerous and are readily caught on hook and line in a tidal lagoon at Horn Island which is designated by the writer as station 10. Kilby (1955) reported young fish from open waters, outer pools, and water-courses at Cedar Key.

Pearson (1929) reported that redfish spawn from the latter part of September to mid-November, and Gunter (1945) presented data which are in agreement with Pearson's (1929) observations. Reid (1954) found no evidence of spawning but remarked that "field experience suggests a late summer of early fall breeding season in the Cedar Key area." Fish with lengths near 300 mm. are estimated to be about one year old, and those near 400 mm. in length are from one to two years old (Pearson, 1929).

Stellifer lanceolatus (Holbrook). Star drum

This species apparently is uncommon in Mississippi waters. Four specimens were taken from station 10 in a trammel net in early June. The fish ranged from 99 to 112 mm. in standard length, from 126 to 143 mm. in total length, and from 125.0 to 141.0 gms. in weight. Hildebrand and Cable (1934) reported the maximum length for this fish to be about 164 mm.

The temperature and salinity at the time of capture were 27.4° C. and 26.0 ppt., respectively.

Gowanloch (1932) reported *S. lanceolatus* as being common in Louisiana waters, and Gunter (1938) found this species to be exceeded in abundance only by *Micropogon undulatus* in trawl catches in Louisiana. Gunter (1945) collected 401 specimens in Texas waters. Reid (1954) and Kilby (1955) did not record the species.

Family Sparidae - Porgies

Archosargus probatocephalus (Walbaum). Sheepshead

All specimens collected during this study were taken in trammel nets. One fish measuring 375 mm. in standard length and 435 mm. in total length and weighing 2,054.6 gms. was taken at station 38 in Nobember 1965. The stomach of the sheepshead was examined and was found to contain two *Cyprinodon variegatus* in addition to a large quantity of unidentifiable material. The temperature and salinity were 18.7°C. and 17.1 ppt., respectively. Three fish ranging from 355.6 to 361.7 mm. in standard length, from 408.3 to 420.4 mm. in total length, and from 907.1 to 1,134.0 gms. in weight were taken together from the same station (station 39) in September 1966. The temperature and salinity at the time of capture were 32.1°C. and 18.0 ppt., respectively.

Lagodon rhomoboides (Linnaeus). Pinfish

One hundred and fifty pinfish were taken. Table 20 shows that all specimens ranged from 21 to 134 mm. in standard length and from 0.1 to 136.0 gms. in weight.

Specimens were obtained at salinities ranging from 2.2 to 29.0 ppt. Catch records show that 71.3 per cent of all collected specimens were from waters with salinities of 18.0 ppt. or higher and 28.7 per cent were taken at salinities of 13.3 ppt. or lower. Kilby (1955) reported that for this species "aquatic vegetation is of greater importance than the degree of salinity in the choice of habitat. "The mean salinity was 12.4 ppt.

Caldwell (1957) has established the spawning season as being in late fall and winter in offshore waters.

Table 20 — Lagodon rhomboides

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	2	65-101	82-124	6.4-32.1	31.0	28.3
Sept 22	10	1	81	101	17.0	28.7	29.0
Nov 2	29	1	134	160	136.0	22.2	22.7
Nov 21	12	1	68	86	6.4	20.8	7.2
Nov 24	4	1	69	85	8.8	20.5	13.1
1966							
June 9	10	53	21-65	25-78	0.1-6.7	25.7	23.0
June 15	18	12	41-66	53-81	1.5-7.3	31.5	13.3
June 17	2	1	59	72	4.4	31.5	5.6
June 20	23	13	41-54	51-69	1.1-3.8	29.0-32.0	27.0
July 2	10	14	41-51	64-80	1.2-4.2	27.0-27.9	26.0
July 6	11	5	37-50	46-53	1.5-3.6	33.0	5.1
July 19	23	6	43-57	55-72	1.3-4.1	28.6-29.5	26.4
July 23	17	10	55-71	68-89	3.4-10.7	29.2-31.0	7.5
July 29	15	1	60	79	5.1	33.3	2.2
July 30	18	2	55-59	67-74	4.0-4.3	31.8	7.0
Aug 2	10	11	42-50	54-65	1.2-1.9	28.9-30.0	24.5
Aug 15	18	10	46-83	59-105	1.5-21.0	31.0	8.1
Sept 1	38	6	55-72	68-90	3.3-10.0	32.1	18.0
						Mean Salinity	12.4

Water Temperatures are presented in Degrees Celsius.

Family Eleotridae - Sleepers

Eleotris pisonis (Gemlin). Spinycheek sleeper

It is the writer's belief that as the flood waters from Hurricane Betsy, September 1965, subsided along the Gulf beach of the island, several small pools were formed at various locations along the beach. During a walk along the Gulf beach on October 19, 1965 three such pools were found. Two of these rather small bodies of water contained an abundance of fishes while the third was practically dry and contained numerous dead and partially decayed fishes.

A total of eight *E. pisonis* was collected on the above date from station 7. Ten partially decayed *E. pisonis* were also observed at this time. The specimens ranged from 76 to 84 mm. in standard length, from 96 to 105 mm. in total length, and from 9.5 to 13.5 gms. in weight. The temperature and salinity were 32.5°C. and 24.8 ppt., respectively.

Briggs (1956) gave the range of this species as being from "Bermuda and South Carolina to Rio de Janeiro and in tributaries on all sides of the Gulf of Mexico." This fish is relatively common along parts of the Mississippi Coast, being found inshore along mud-bottomed areas. Baughman (1950) reported this fish from Texas, and Hoese (1958) stated that one specimen had been seen at Galveston.

Family Gobiidae - Gobies

Evorthodus lyricus (Girard). Lyre goby

A total of nine specimens was taken, and catch data are presented in table 21.

Eight live lyre gobies were taken from the pools at station 7. Five partially decayed fish of this species were noted. In addition to *E. lyricus* several *Eleotris pisonis* (previously discussed) and *Lucania parva* were obtained from the pools.

Sexual dimorphism in this species first led to the placement of both sexes in different genera; the male being considered as *Gobius lyricus* and the female as *Evorthodus breviceps.* Ginsburg (1931) reported that both were the same species, and noted that this fish was not found on the open beach in Louisiana but was somewhat localized to a few salt water ponds. Ginsburg (1931) furthermore added that this species was most abundant in two mud-bottomed, marshy lagoons which connected with Barataria Bay and became disconnected ponds at low tide.

Gunter (1945) reported taking thirty-one specimens of this goby. Briggs (1956) gave the range of this species as being from Chesapeake Bay to Guiana and throughout the Gulf of Mexico.

TABLE 21 — Evorthodus lyricus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Oct 19	7	5	44-62	67-86	3.0-6.0	32.5	24.8

(Table 21 continued)

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1966							
July 29	15	2	44-68	71-96	2.9-6.5	33.5	2.2
July 30	18	2	46-57	69-79	3.2-4.5	31.8	7.0
						Mean Salinity	15.8

Water Temperatures are presented in Degrees Celsius.

Gobionellus boleosoma (Jordan and Gilbert). Darter goby

A total of eight specimens was taken, and catch data are presented in table 22. Two specimens were captured in August 1965 from the tidal channel at station 10, and in June 1966 two fish were also taken at station 10 in a marsh area far removed from the tidal channel. Four specimens were collected in rather muddy, shallow water at station 18 in late July 1966.

Gunter (1945) collected ripe females in November in Copano Bay. Reid (1954) found no indications of breeding from the larger fish at Cedar Key.

Gobionellus boleosoma exhibited an interesting association with *Gobiosoma bosci* in that both were taken in the same seine hauls, and neither were collected separately.

TABLE 22 – Gobionellus boleosoma

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	2	26-28	33-35	0.4-0.6	29.3	28.3
1966							
June 9	10	2	22-23	29	0.4-0.7	25.7	23.0
July 30	18	4	41-45	52-56	1.2-2.0	31.8-32.0	7.0
						Mean Salinity	16.3

Water Temperatures are presented in Degrees Celsius.

Gobiosoma bosci (Lacépède). Naked goby

A total of five naked gobies was taken from two stations, and

catch data are given in table 23. The smallest (15 mm. in total length) and the largest (44 mm. in total length) specimens were taken in August and July, respectively.

Dawson (1966) found indications of a size-salinity relationship for *G. bosci;* a relationship (differing in respect to many fishes) in which members of the medium standard length classes prefer low salinities and "...younger fish are most common at moderate salinities." During the present study *G. bosci* was found at salinities ranging from 7.0 to 28.3 ppt., and as a point of interest it might be noted that the smallest specimen was taken in waters of relatively high salinity, while the largest fish was taken from low salinity waters.

An extended spawning period from early spring through late summer in Mississippi Sound was suggested by Dawson (1966), and he also presented information concerning the growth rate of this species.

TABLE 23 – Gobiosoma bosci

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	3	12-31	15-39	0.1-0.8	29.3	28.3
1966							
June 9	10	1	25	31	0.7	25.7	23.0
July 30	18	1	36	44	1.1	32.0	7.0
						Mean Salinity	23.0

Water Temperatures are presented in Degrees Celsius.

Microgobius gulosus (Girard). Large-mouthed goby

A total of seventy-one specimens was obtained at ten stations and catch data are given in catch table 24. The fish ranged from 22 to 45 mm. in standard length and from 0.2 to 1.3 gms. in weight.

Microgobius gulosus was taken at a rather wide salinity range and specimens were found in both rather deep and shallow water areas in which the bottoms with few exceptions were quite muddy.

Reid (1954) and Kilby (1955) reported indications of an extended

breeding season. Kilby (1955) also remarked that "the presence of individuals of 25 mm. or less during all seasons of the year indicates either a continuous breeding season, or very slow growth of the young."

Reid (1954) reported that fish taken from flats throughout the year exhibit seasonal coloration and added that "these variations were probably reflections of the seasonal distribution and abundance of vegetation on the flats." This species is considered to be euryhaline as indicated by its presence in the St. John's River, Florida (Evermann and Kendall, 1900, *fide* Kilby 1955).

TABLE 24 — Microgobius gulosus

Date	Station	No. of Specimens male	female	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965								
Nov 17	38		4	36-45	47-59	0.6-1.3	18.9	17.1
Nov 19	14	4	10	22-43	27-55	0.6-1.2	20.0-21.4	9.3
1966								
July 2	10	10	5	28-38	35-49	0.3-0.8	27.0-27.9	26.0
July 25	19		1	29	38	0.4	29.6	15.1
July 26	21		3	27-31	36-40	0.4-0.5	32.6	14.3
July 29	15	1	7	27-45	34-57	0.4-0.8	33.3-33.5	2.2
July 30	18	3	13	22-33	26-43	0.2-0.6	31.8	7.0
Aug 2	10	1	2	28-29	37-39	0.4	30.0	24.5
Aug 20	23	1	1	32-43	42-56	0.5-0.7	31.6	26.1
Aug 26	34		1	39	51	0.9	31.0	19.0
Aug 26	35		3	27-28	36-37	0.3	32.0	18.3
Sept 1	38	1		44	56	1.3	32.5	18.0
							Mean Salinity	14.2

Water Temperatures are presented in Degrees Celsius.

Family Triglidae - Searobins

Prionotus pectoralis Nichols and Breder. Blackwing searobin

Prionotus pectoralis was taken twice. One specimen measuring 69 mm. in standard length and 87 mm. in total length and weighing 7.6 gms. was taken in a seine at station 12 in November 1965, The second fish was captured in a trammel net at station 38 in September 1966. This specimen measured 152 mm. in standard length and 190 mm. in total length and weighed 43.1 gms. The temperatures at stations 12 and 38 were 20.8 and 32.5°C., and the salinities were 7.2 and 18.0 ppt., respectively.

Prionotus scitulus Jordan and Gilbert. Slender searobin

Three specimens of this searobin were taken during the present study. Two were collected in shallow water at station 10 in August 1965. The temperature was 30.6°C., and the salinity was 28.3 ppt. The fish measured 38 and 44 mm. in standard length and 47 and 58 mm. in total length and weighed 1.3 and 1.6 gms., respectively. A single specimen was captured at station 38 in September 1966. The fish measured 127 mm. in standard length and 165 mm. in total length and weighed 31.5 gms. The temperature and salinity were 32.5°C. and 18.0 ppts., respectively.

Reid (1954) reported a female (145 mm. in length) which showed slight ovarian development in November and a male (147 mm. in length) which appeared almost ripe in December. Reid (1954) noted that young fish, 20 to 25 mm. in length, were taken during the months of May, June, August, October, and January.

Family Uranoscopidae - Stargazers

Astroscopus y-graecum (Cuvier). Southern stargazer

One large stargazer was taken in November in the tidal channel at station 10 shortly before low tide. The fish measured 155 mm. in standard length and 193 mm. in total length and weighed 151.7 gms. The temperature and salinity were 19.0°C. and 29.9 ppt., respectively.

A shock of small magnitude was experienced while placing the specimen in the preservative, sufficiently satisfying the writer's curiosity concerning the electric organs. Gunter (1945) noted that the shocking power is used in getting food and might possibly be employed in repelling enemies.

Family Blenniidae - Blennies

Hypsoblennius ianthus (Jordan and Gilbert). Freckled blenny

One *H. ianthus* was collected in several inches of water in August 1966 at station 34. The specimen measured 20 mm. in standard length and 26 mm. in total length. A weight of 2.0 gms. was recorded for this fish. The temperature and salinity were 29.1°C. and 19.9 ppt., respectively.

Family Ophidiidae - Cusk-eels

Lepophidium jeannae Fowler. Mottled cusk-eel

One *L. jeannae* taken from station 16 in October 1965 was the only cusk-eel collected during the study. The specimen measured 53.5 mm. in standard length and 55.0 mm. in total length and weighed 0.6 gm. The temperature and salinity were 26.9^{0}C. and 20.0 ppt., respectively.

Family Sphyraenidae - Barracudas

Sphyraena barracuda (Walbaum). Great barracuda

A single small specimen was collected in November 1965 at station 38, a landlocked lagoon. The fish measured 66 mm. in standard length and 75 mm. in total length and weighed 1.6 gms. The temperature and salinity were 17.1^{0}C. and 18.9 ppt., respectively.

DeSylva (1963) discussed the ecology of young barracuda, and remarked on their disappearance from inshore areas and movement to deeper water with the onset of winter. The present specimen could have reached station 38 during Hurricane Betsy, assuming that this young individual was offshore before the storm. Young barracuda are often numerous in waters surrounding Horn Island during middle and late fall.

Family Mugilidae - Mullets

Mugil cephalus Linnaeus. Striped mullet

Four hundred and twenty-one striped mullet were collected. Gunter (1941) listed *M. cephalus* as one of the four most abundant fishes of the northern Gulf coast. During the present study the majority of specimens were taken in seines; however, a few relatively large specimens were captured in a trammel net. It may be noted that numerous fish avoided capture by leaping over the seines.

Catch data in table 25 show that specimens rnaged from 20 to 238 mm. in standard length and from 2.3 to 345.0 gms. in weight.

Spawning *M. cephalus* were observed in a tidal flow on La Costa Island, Florida in February (Breder, 1940). Gunter (1945) noted that large mullet go to the Gulf in the fall, and spawning occurs from late October to January in the passes on the outside beach. Gunter (1945) found young mullet to be most abundant in January. Reid (1954) collected young from January through March "in shallow waters of sandy beaches" at Cedar Key. Kilby (1955) found a breeding season from October through July at Bayport, and noted that young were taken primarily in the "outer and inner pools" at both Bayport and Cedar Key. Anderson (1958) reported spawning to be offshore from October to February along the south Atlantic coast, and further noted that young apparently move into the "marshy estuarine waters" during January.

During the present study several young ranging from 25 to 37 mm. in total length were taken from two enclosed drainage ditches in December 1965 and in January 1966; adults were neither taken nor observed on either occasion. During August 1965 in collections which were preliminary to the present study neither young nor adul' *M. cephalus* were taken from either drainage ditch. The specimens probably entered the ditches during a period of high waters.

Specimens were collected at temperatures and salinities ranging from 16.0 to 33.0°C. and from 1.7 to 27.0 ppt., respectively. The mean salinity was 8.0 ppt.

TABLE 25 — Mugil cephalus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Oct 27	23	1	140	161	59.5	26.9	23.0
Nov 2	29	1	156	196	73.6	22.2	22.7
Nov 17	38	5	89-231	115-294	13.9-272.6	18.4-18.9	17.1
Nov 19	14	2	235-238	296-300	352.0-354.0	21.4	9.3
Dec 22	2	25	21-25	25-37	0.1-0.2	16.5	5.0
1966							
Jan 10	4	300	20-27	24-32	0.1-0.3	16.0	5.2
June 17	2	1	56	66	6.8	31.5	5.6
June 20	23	5	83-115	103-124	14.3-23.2	32.0	27.0
July 2	10	2	238	300	291.5	27.4	26.0
July 6	11	16	52-67	64-82	4.1-10.7	33.0	5.1
July 19	23	29	56-107	70-136	4.0-51.2	28.6-31.0	26.4
July 21	6	1	71	86	9.9	30.0	5.5

(Table 25 continued)

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
July 27	1(B)	2	46-50	56-61	2.8-4.0	32.7	1.7
July 27	1(C)	6	61-72	73-87	6.1-10.0	32.8	1.7
July 27	1(D)	8	44-65	53-81	2.3-8.3	32.8	1.7
Aug 2	10	12	48-87	61-109	3.1-26.5	28.9-30.0	24.5
Aug 20	23	6	71-117	88-149	11.4-58.5	31.6	26.1
						Mean Salinity	8.0

Water Temperatures are presented in Degrees Celsius.

Mugil curema Valenciennes. Silver mullet

Seventy-two silver mullet were taken, and catch data are presented in catch table 26. Kilby (1955) reported that all of his specimens were taken from marsh pools with a mud bottom, and during the present study the majority of fish were also collected from waters over a mud bottom. Reid (1954) failed to take this species at the Cedar Key area.

Specimens ranged from 21 to 232 mm. in standard length and from 0.2 to 285.0 gms. in weight. Large fish were not prevalent; however, several were captured in trammel nets.

This species was found at a rather wide salinity range, 0.6 to 29.0 ppt., and temperatures ranged from 14.1 to 32.5^{0}C. The mean salinity was 8.1 ppt.

Kilby (1955) found fish of 30 mm. or less in length from March to June. Anderson (1957), in addition to presenting information on early development and growth of this species, reported indications of a spring spawning season extending from late March or early April until September. Gunter (1945) noted an apparent spawning period in the late winter and spring in Texas.

TABLE 26 – Mugil curema

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	2	36-37	44-45	0.6-0.6	31.0	28.3
Oct 19	38	2	78-82	100-106	11.0-12.0	18.9	17.1
Nov 2	12	2	71-77	88-97	12.0-13.0	20.8	7.2

(Table 26 continued)

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
Nov 17	2	3	71-99	89-126	12.0-23.0	16.5	5.0
Nov 21	5	1	84	104	13.2	26-5	29.0
Nov 24	4	2	74-79	90-99	8.7-12.2	20.5	13.1
Dec 22	3	32	60-95	75-117	8.0-18.0	14.1	5.3
Dec 22	29	3	61-225	75-285	8.4-224.0	22.2	22.7
1966							
June 9	10	9	21-41	26-49	0.2-0.4	26.0	23.0
June 15	16	1	55	66	6.5	31.5	26.9
July 30	18	2	37-51	45-63	4.2-6.0	32.0	7.0
Aug 23	33	6	198-232	252-294	191.0-285.0	32.5	0.6
Aug 29	37	3	59-70	74-87	6.0-9.0	31.8	11.0
Sept 1	38	4	197-230	277-292	240.0-275.0	32.5	18.0
						Mean Salinity	8.1

Water Temperatures are presented in Degrees Celsius.

Family Atherinidae - Silversides

Membras martinica (Valenciennes). Rough silverside

Twenty-six specimens were taken, and catch data are given in table 27. Specimens ranged from 22 to 91 mm. in standard length and from 0.1 to 7.8 gms. in weight. A rather large specimen measuring 109 mm. in total length was collected in August 1966. Gunter (1945) found this species to be most abundant during summer months.

Salinities ranged from 9.3 to 26.0 ppt. Gunter (1945) reported that this species was most abundant in the freshest water and high salinity water with fewer fishes being caught at intermediate salinities. Fish were taken at a mean salinity of 23.3 ppt.

Gunter (1945) found ripe males and females from 63 to 85 mm. length in March and April along the Texas coast and noted that young came into the catches as late as October. Reid (1954) found females ranging from 65 to 75 mm. in length with mature ova in March and noted that fish were not taken during the winter months.

TABLE 27 – Membras martinica

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Nov 19	14	3	22-60	26-72	0.1-1.2	21.4	9.3
1966							
July 2	10	9	31-57	38-68	0.6-2.4	27.4-28.0	26.0
Aug 2	10	14	44-91	54-109	0.9-7.8	28.9-30.0	24.5
						Mean Salinity	23.3

Water Temperatures are presented in Degrees Celsius.

Menidia beryllina (Cope). Tidewater silverside

Four thousand eight hundred and seventy-six specimens, constituting 17.1 per cent of the total catch, were taken in 72.1 per cent of all collections. *Menidia beryllina* was second in abundance only to *Poecilia latipinna*.

This euryhaline species was collected in thickly vegetated marsh areas as well as in open waters. Specimens ranged from 15 to 87 mm. in standard length and from 0.1 gm. to 7.5 gms. in weight. Kilby (1955) reported that at Cedar Key a 99 mm. specimen probably constituted a record size. During the present study twelve large fish ranging from 100 to 103 mm. in total length were taken.

Specimens were taken at temperatures ranging from 14.1 to 33.5° C. salinities ranging from 0.6 to 29.9 ppt. Gunter's (1945) specimens in Texas were taken at a mean salinity of 17.5 ppt. During the present study fish were taken at a mean salinity of 20.3 ppt. From catch data in table 28 it is determined that 58.9 per cent of all specimens were taken at salinities of 22.5 ppt. or higher, and 41.1 per cent were taken at salinities of 18.3 ppt. or lower.

Gunter (1945) collected a large number of specimens in Texas and noted the possibility of two spawning peaks. Springer and Woodburn (1960) found similar indications for the Tampa area with the major spawning period extending from spring into early summer.

TABLE 28 – Menidia beryllina

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	38	21-57	26-71	0.1-1.9	29.3-31.0	28.3
Sept 22	10	121	19-70	24-88	0.1-3.7	28.2-28.9	29.0
Oct 12	16	3	30-30	35-35	0.3-0.3	26.9	23.0
Oct 19	5	164	15-69	28-86	0.1-3.5	26.5	29.0
Oct 19	8	1	51	62	2.1	26.9	3.9
Oct 27	23	24	15-48	21-53	0.3-1.0	26.9	23.0
Nov 2	29	160	33-70	40-86	1.5-3.0	21.7-22.2	22.7
Nov 4	30	17	50-72	62-86	1.3-3.5	21.0	2.6
Nov 4	31	17	49-73	61-88	0.9-3.4	21.1	2.1
Nov 4	32	10	43-69	53-83	1.0-3.8	21.2	11.3
Nov 11	40	13	41-54	50-65	1.7-2.4	18.5	27.1
Nov 11	44	6	42-50	52-61	0.4-1.2	21.0	27.0
Nov 11	45	13	39-53	53-64	0.6-1.2	20.5	22.5
Nov 17	38	142	33-64	42-78	1.2-5.3	18.4-18.9	17.1
Nov 19	13	133	29-66	36-75	0.7-3.8	20.0	12.1
Nov 19	14	3	54-57	64-68	1.0-2.6	20.8-21.4	9.3
Nov 24	2	21	47-78	58-92	1.0-5.0	20.0	9.1
Nov 24	4	4	53-65	64-79	1.4-2.4	20.5	13.1
Nov 26	10	71	42-72	57-89	1.3-5.0	18.4-18.7	29.9
Dec 22	2	18	51-62	61-82	2.4-4.6	16.5	5.0
Dec 22	3	17	45-65	55-78	1.4-3.8	14.1	5.3
1966							
June 9	10	207	27-64	35-76	1.7-2.4	25.1-26.0	23.0
June 15	16	6	24-36	30-44	1.2-1.9	30.5-31.2	26.9
June 15	18	270	25-63	31-76	1.2-2.4	31.5	13.3
June 17	2	6	25-36	30-44	1.0-1.3	31.5	5.6
June 20	23	286	36-61	42-73	1.4-2.7	29.0-32.0	27.0
June 24	24	16	25-41	29-51	0.3-1.5	30.3	4.6
July 2	10	528	33-66	39-79	0.5-3.6	27.0-27.9	26.0
July 4	27	14	23-75	28-90	0.1-7.5	31.8	12.4
July 6	11	47	24-64	28-79	0.1-3.5	33.0	5.1
July 11	28	22	39-74	48-89	0.8-7.4	29.4-30.8	3.0
July 19	23	516	21-54	25-65	0.1-1.7	28.6-31.0	26.4
July 23	17	6	25-36	30-43	0.1-0.6	29.2-31.0	7.5
July 27	1(A)	2	59-62	70-76	1.8-1.9	32.7	1.7
July 27	1(B)	5	33-35	40-43	0.6-0.7	32.7	1.7
July 27	1 (D)	1	57	67	1.2	32.8	1.7
July 29	15	4	22-59	25-71	0.9-2.8	33.3-33.5	2.2
July 30	18	590	23-59	27-70	0.1-2.0	31.8-32.0	7.0
Aug 2	10	269	30-87	36-103	0.3-7.3	28.9-30.0	24.5
Aug 15	18	519	27-83	32-100	0.2-6.1	29.4-31.0	8.1
Aug 20	23	345	22-58	27-69	0.1-2.0	31.6-32.5	26.1
Aug 23	33	10	57-65	67-78	1.8-2.5	31.8-32.5	0.6
Aug 26	34	60	18-54	23-65	0.1-1.6	31.7-32.0	18.3
Aug 29	36	13	27-51	32-63	0.2-1.5	31.0-31.5	10.8
Aug 29	37	37	20-51	26-62	0.1-1.4	31.6-31.8	11.0
Aept 1	38	1	53	64	1.3	32.1	18.0
						Mean Salinity	20.3

Water Temperatures are presented in Degrees Celsius.

Order Pleuronectiformes

Family Bothidae - Lefteyed flounders

Etropus crossotus Jordan and Gilbert. Fringed flounder

During the present study seven specimens were collected, and catch records are presented in table 29. The fish were seined over bottoms ranging from hard sand to extremely soft mud.

Gunter (1945) indicated that *E. crossotus* apparently seldom ventures into brackish water, and Gunter and Hall (1965) found *E. crossotus* at salinities ranging from 18.0 to 33.7 ppt. During the present study salinities ranging from 7.5 to 27.0 ppt. were noted for waters from which specimens were taken.

Reid (1954) collected small fish (23 to 25 mm.) in June and October and suggested an extended breeding season during spring and summer. Miller (1965) presented data which supports the spawning period reported by Reid (1954).

TABLE 29 – Etropus crossotus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1966							
June 20	23	3	44-54	55-68	1.2-2.1	31.8-32.0	27.0
July 23	17	2	42-46	54-60	1.1-1.3	29.2	7.5
Aug 26	34	2	51-55	65-72	3.0-3.5	29.1	19.0
						Mean Salinity	19.1

Water Temperatures are presented in Degrees Celsius.

Citharichthys spilopterus Günther. Bay whiff

Only one fish was taken during the present study, and it was collected in November 1965 at station 12. The bottom was extremely muddy and soft; a fact which made seining quite difficult. The specimen measured 70 mm. in standard length and 83 mm. in total length and weighed 10.4 gms. The temperature and salinity were 18.9^{0}C. and 7.2 ppt., respectively.

Gunter (1945) caught this fish at salinities ranging from 2.5 to 36.7 ppt.; however, he noted that it was most abundant at salinities above 15.0 ppt.

Paralichthys albigutta Jordan and Gilbert. Gulf flounder

Four specimens were collected, and all fish were taken from station 10 in shallow water over a sand bottom. One fish measuring 91 mm. in standard length and 118 mm. in total length and weighing 14.8 gms. was taken in August 1965. The temperature and salinity were 31.0°C. and 28.3 ppt., respectively. Three specimens were obtained in June 1966. These fish ranged from 42 to 83 mm. in standard length, from 52 to 102 mm. in total length, and from 1.8 to 13.5 gms. in weight. Temperatures ranged from 25.7 to 26.0°C., and the salinity was 23.0 ppt.

Gunter (1945) took only twelve specimens of *P. albigutta* in Texas. Jordan and Swain (1884) and Reid (1954) noted that this species was the most common of the flounders at Cedar Key, Florida. Kilby (1955) reported only one specimen from a marsh pool at Cedar Key.

Reid (1954) noted for this species a breeding season at Cedar Key which appeared to be in late fall or early winter and added that growth appeared to be rapid up to 55 mm. The writer took two specimens in June 1966 measuring 52 and 61 mm. in total length.

Paralichthys lethostigma Jordan and Gilbert. Southern flounder

A total of five specimens was taken during the present study, and table 30 presents the catch data for this species. Three fish were collected in seines, and two specimens were snared in a trammel net.

The salinity range at which the specimens were captured was from 8.1 to 18.0 ppt. The mean salinity was 15.7 ppt. Gunter (1945), in respect to his study in Texas, states: "Apparently this fish, at least in the sizes caught, prefers bay and less salty water."

Stomachs of the two specimens taken in November 1965 were examined; the stomach of a 494 mm. (total length) fish contained an entire *C. variegatus*, three partially digested *M. beryllina*, one penaeid shrimp, and a small quantity of unidentifiable material.

Four *C. variegatus* and one penaeid shrimp were taken from the stomach of a 277 mm. (total length) fish.

TABLE 30 — Paralichthys lethostigma

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Nov 17	38	2	222-438	277-494	206.0-567.0	18.9	17.1
1966							
Aug 15	18	1	188	221	125.4	29.4	8.1
Sept 1	38	2	186-419	220-475	160.0-907.0	31.3	18.0
						Mean Salinity	15-7

Water Temperatures are presented in Degrees Celsius.

Family Soleidae - Soles

Trinectes maculatus (Bloch and Schneider). Southern hogchoker

A total of four specimens was taken, and catch data are presented in table 31. Seine hauls in which the fish were taken were made over bottoms consisting of sand and very little mud.

Kilby (1955) noted that this fish has been taken from several "fresh water situations in Florida." This euryhaline species was taken by Gunter (1945) in greatest numbers in salinities above 30.0 ppt. Gunter and Hall (1965) collected over four hundred specimens at a mean salinity of 1.98 ppt. The specimens taken during the present study were collected at salinities ranging from 8.1 to 26.4 ppt., with a mean salinity of 15.3 ppt. Temperatures ranged from 25.7 to 31.0° C.

TABLE 31 — Trinectes maculatus

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1966							
June 15	18	2	65-76	80-95	12.0-18.0	25.7-26.0	13.3
July 19	23	1	96	117	22.1	286	26.4
Aug 15	18	1	65	80	10.5	29.4-31.0	8.1
						Mean Salinity	15.3

Water Temperatures are presented in Degrees Celsius.

Family Cynoglossidae - Tonguefishes

Symphurus plagiusa (Linnaeus). Tonguefish

Six tonguefish were collected, and catch data are presented in table 32. *Symphurus plagiusa* was taken at salinities and temperatures ranging from 18.0 to 28.3 ppt. and from 26.9 to 32.5^{0}C., respectively. Gunter (1945) collected several tonguefish at salinities ranging from 17.1 to 36.7 ppt. and remarked that this species shows preference for waters of high salinity. Reid (1954) took specimens at Cedar Key after a hurricane from waters with a salinity of 15.4 ppt.

Springer and Woodburn (1960) captured their smallest specimen during October in the Tampa area. Gunter and Hall (1963) found the smallest fish in the St. Lucie estuary during October. During the present study the smallest specimen, 24 mm. in standard length, was also collected in October.

TABLE 32 - Symphurus plagiusa

Date	Station	No. of Specimens	Standard Length (mm.)	Total Length (mm.)	Weight (gm.)	Water Temperature	Salinity (ppt.)
1965							
Aug 18	10	2	25-50	28-54	0.5-1.1	29.3-30.6	28.3
Oct 27	23	2	24-40	27-44	0.4-0.9	26.9-27.1	23.0
1966							
Aug 20	23	1	106	115	14.1	31.6-32.5	26.1
Sept 1	38	1	102	111	12.0	31.3	18.0
						Mean Salinity	24.5

*Water temperatures are presented in degrees celsius.

Order Gobiesociformes

Family Gobiesocidae - Clingfishes

Gobiesox strumosus Cope. Clingfish

A single, small specimen of *G. strumosus* was collected in September 1966 at station 38. The fish measured 21 mm. in standard length

and 27 mm. in total length and weighed 0.3 gms. The temperature and salinity were 32.5° C. and 18.0 ppt., respectively.

Order Tetraodontiformes

Family Balistidae - Triggerfishes and Filefishes

Alutera schoepfi (Walbaum) Orange filefish

A single specimen measuring 84 mm. in standard length and 155 mm. in total length and weighing 4.1 gms. was taken at station 12 in November 1965. The temperature was 20.8° C. and the salinity was 7.2 ppt.

Order Batrachoidiformes

Family Batrachoididae - Toadfishes

Porichthys porosissimum (Cuvier). Midshipman

A single specimen measuring 112 mm. in standard length and 125 mm. in total length and weighing 33.3 gms. was collected at station 10 in July 1966. The temperature was 27.4° C., and the salinity was 26.0 ppt.

DISCUSSION

Members of the families Poeciliidae, Cyprinodontidae, Atherinidae, Mugilidae, Sciaenidae, Engraulidae, Sparidae, and Gobiidae were the significant components of the Horn Island ichthyofauna (tables 4, 5, 6, 7, and 8), in that each was represented in respectable numbers, and all were collected from the majority of stations. The number of specimens within these families comprised 99.2 per cent of the total catch.

As shown in table 5 members of the families Poeciliidae, Cyprinodontidae, and Atherinidae contributed most conspicuously to the fish population. Other families which were encountered formed somewhat less conspicuous elements in the population. *Cyprinodon variegatus, Fundulus similis, Gambusia affinis, Menidia beryllina,* and *Poecilia latipinna* were found to be quite abundant and were encountered most

TABLE 4
NUMBER OF TIMES SPECIES COLLECTED AND NUMBER OF SPECIMENS

	Total	
	Times Taken	Number
Negaprion brevirostris	1	1
Sphyrna tiburo	1	1
Dasyatis sabina	2	3
Lepisosteus oculatus	1	1
Lepisosteus spatula	4	19
Elops saurus	2	2
Megalops atlanticus	2	2
Alosa chrysochloris	1	1
Dorosoma petenense	1	1
Harengula pensacolae	2	5
Anchoa hepsetus	5	253
Anchoa mitchilli	4	32
Synodus foetens	3	5
Galeichthys felis	3	14
Strongylura marinus	2	2
Hyporhamphus unifasciatus	1	1
Adinia xenica	14	209
Cyprinodon variegatus	46	4,532
Fundulus grandis	24	146
Fundulus pulvereus	4	8
Fundulus similis	44	3,782
Lucania parva	21	1,996
Gambusia affinis	29	4,592
Poecilia latipinna	46	6,782
Syngnathus louisianae	3	9
Syngnathus scovelli	2	2
Centropristes philadelphicus	2	2
Caranx crysos	1	1
Caranx hippos	1	1
Caranx latus	2	5
Chloroscombrus chrysurus	1	1
Oligoplites saurus	2	14
Eucinostomus argenteus	6	83
Orthopristis chrysopterus	1	9
Bairdiella chrysura	1	237
Cynoscion nebulosus	7	58
Larimus fasciatus	2	7
Leiostomus xanthurus	7	43
Menticirrhus americanus	3	11

TABLE 4
(continued)

	Times Taken	Number
Menticirrhus littoralis	1	6
Micropogon undulatus	3	13
Sciaenops ocellatus	2	2
Stellifer lanceolatus	1	4
Archosargus probatocephalus	2	4
Lagodon rhomboides	2	4
Eleotris pisonis	1	8
Evorthodus lyricus	3	9
Gobionellus boleosoma	3	8
Gobiosoma bosci	3	5
Microgobius gulosus	12	71
Prionotus pectoralis	2	2
Prionotus scitulus	2	3
Astroscopus y-graecum	1	1
Hypsoblennius ianthus	1	1
Lepophidium jeannae	1	1
Sphyraena barracuda	1	1
Mugil cephalus	13	421
Mugil curema	15	72
Membras martinica	3	26
Menidia beryllina	44	4,876
Etropus crossotus	3	7
Citharichthys spilopterus	1	1
Paralichthys albigutta	2	4
Paralichthys lethostigma	3	5
Trinectes maculatus	3	4
Symphurus plagiusa	4	6
Gobiesox strumosus	1	1
Alutera schoepfi	1	1
Porichthys porosissimum	1	1

TABLE 5
CONTRIBUTION OF EACH FAMILY TO TOTAL CATCH

FAMILY	COMMON NAME	SPECIES DENSITY	TOTAL NUMBER OF SPECIMENS
Poeciliidae	Livebearers	2	11,374
Cyprinodontidae	Killifishes	6	10,673
Atherinidae	Silversides	2	4,902
Mugilidae	Mullets	2	493
Sciaenidae	Croakers & Drums	9	381
Engraulidae	Anchovies	2	285
Sparidae	Porgies	2	154
Gobiidae	Gobies	4	93
Leiognathidae	Mojarras	1	83
Carangidae	Jacks & Pompanos	5	22
Lepisosteidae	Gars	2	20
Bothidae	Lefteyed flounders	4	17
Ariidae	Marine catfishes	1	14
Syngnathidae	Pipefishes	2	11
Pomadasyidae	Grunts	1	9
Eleotridae	Sleepers	1	8
Clupeidae	Herrings	3	7
Cynoglossidae	Tonguefishes	1	6
Synodontidae	Lizard fishes	1	5
Triglidae	Sea robins	2	5
Soleidae	Soles	1	4
Elopidae	Tenpounders & Tarpons	2	4
Dasyatidae	Stingrays	1	3
Serranidae	Sea basses	1	2
Belonidae	Neddlefishes	1	2
Carcharhinidae	Requiem sharks	1	1
Sphyrnidae	Hammerhead sharks	1	1
Hemiramphidae	Halfbeaks	1	1
Sphyraenidae	Barracudas	1	1
Uranoscopidae	Stargazers	1	1
Batrachoididae	Toadfishes	1	1
Ophidiidae	Cusk-eels	1	1
Blenniidae	Blennies	1	1
Gobiesocidae	Clingfishes	1	1
Balistidae	Filefishes	1	1

TABLE 6
LIST OF FISHES CAUGHT WITH LESS THAN 100 SPECIMENS IN THE TOTAL CATCH

1 Specimen

Negaprion brevirostris
Sphyrna tiburo
Lepisosteus oculatus
Alosa chrysochloris
Dorosoma petenense
Hyporhamphus unifasciatus
Caranx crysos
Caranx hippos
Chloroscombrus chrysurus
Sphyraena barracuda
Astroscopus y-graecum
Hypsoblennius ianthus
Lepophidium jeannae
Citharichthys spilopterus
Gobiesox strumosus
Alutera schoepfi
Porichthys porosissimum

2 to 4 Specimens

Dasyatis sabina
Elops saurus
Megalops atlanticus
Strongylura marinus
Syngnathus scovelli
Centropristes philadelphicus
Archosargus probatocephalus
Sciaenops ocellatus
Stellifer lanceolatus
Prionotus pectoralis
Prionotus scitulus
Paralichthys albigutta
Trinectes maculatus

5 to 10 Specimens

Harengula pensacolae
Synodus foetens
Fundulus pulvereus
Syngnathus louisianae
Caranx latus
Orthopristis chrysopterus

(continued)

Larimus fasciatus
Menticirrhus littoralis
Eleotris pisonis
Evorthodus lyricus
Gobionellus boleosoma
Gobiosoma bosci
Etropus crossotus
Paralichthys lethostigma
Symphurus plagiusa

11 to 25 Specimens

Lepisosteus spatula
Galeichthys felis
Oligoplites saurus
Menticirrhus americanus
Micropogon undulatus

26 to 50 Specimens

Anchoa mitchilli
Leiostomus xanthurus
Membras martinica

51 to 100 Specimens

Eucinostomus argenteus
Cynoscion nebulosus
Microgobius gulosus
Mugil curema

Total - 611
Percentage of Total Catch - 2.1

TABLE 7
TOTAL NUMBER AND PERCENTAGE OF THE TOTAL CATCH (IN DECREASING ORDER) FOR ALL SPECIES WITH MORE THAN 100 SPECIMENS

SCIENTIFIC NAME	COMMON NAME	CATCH TOTAL NO.	PERCENTAGE OF TOTAL CATCH
Poecilia latipinna	Sailfin molly	6,782	23.7
Menidia beryllina	Tidewater silverside	4,876	17.1
Gambusia affinis	Mosquitofish	4,592	16.1
Cyprinodon variegatus	Southern sheeps-head killifish	4,532	15.9
Fundulus similis	Longnose killifish	3,782	13.2
Lucania parva	Rainwater killifish	1,996	7.0
Mugil cephalus	Striped mullet	421	1.5
Anchoa hepsetus	Striped anchovy	253	.9
Bairdiella chrysura	Silver perch	237	.8
Adinia xenica	Diamond killifish	209	.7
Lagodon rhomboides	Pinfish	150	.5
Fundulus grandis	Gulf killifish	146	.5
	Total:	27,976	97.9

TABLE 8
TOTAL NUMBER OF SPECIES TAKEN BY ALL TYPES OF COLLECTION GEAR

SPECIES	SEINES	TRAMMEL NETS	BRAIL NET	CAST NET
Negaprion brevirostris		1		
Sphyrna tiburo		1		
Dasyatis sabina	3			
Lepisosteus oculatus		1		
Lepisosteus spatula	1	18		
Elops saurus		2		
Megalops atlanticus	2			
Alosa chrysochloris	1			
Dorosoma petenense		1		

TABLE 8
(continued)

SPECIES	SEINES	TRAMMEL NETS	BRAIL NET	CAST NET
Harengula pensacolae	5			
Anchoa hepsetus	253			
Anchoa mitchilli	32			
Synodus foetens	5			
**Galeichthys felis*	14			
Strongylura marina	2			
Hyporhamphus unifasciatus			1	
Adinia xenica	209			
Cyprinodon variegatus	4,520		12	
Fundulus grandis	142		4	
Fundulus pulvereus	8			
Fundulus similis	3,771			11
Lucania parva	1,990			6
Gambusia affinis	4,592			
Poecilia latipinna	6,778			4
Snygnathus louisianae	9			
Syngnathus scovelli	2			
Centropristis philadelphicus	2			
Caranx crysos		1		
Caranx hippos	1			
Caranx latus	5			
Chloroscombrus chrysurus		1		
Oligoplites saurus	14			
Eucinostomus argenteus	83			
Orthopristis chrysopterus	9			
Bairdiella chrysura	237			
Cynoscion nebulosus	57	1		
Larimus fasciatus	1	6		
Leiostomus xanthurus	37	6		
Menticirrhus americanus	11			
Menticirrhus littoralis	6			
Micropogon undulatus		13		
Sciaenops ocellatus		2		
Stellifer lanceolatus		4		
Archosargus probatocephalus		4		
Lagodon rhomboides	149			
Eleotris pisonis	8			
Evorthodus lyricus	9			
Gobionellus boleosoma	8			
Gobiosoma bosci	5			
Microgobius gulosus	71			
Prionotus pectoralis	1	1		
Prionotus scitulus	2	1		

TABLE 8
(continued)

SPECIES	SEINES	TRAMMEL NETS	BRAIL NET	CAST NET
Astroscopus y-graecum		1		
Hypsoblennius ianthus		1		
Lepophidium jeannae		1		
Sphyraena barracuda		1		
Mugil cephalus		414	7	
Mugil curema		64	12	1
Membras martinica		26		
Menidia beryllina		4,876		
Etropus crossotus		7		
Citharichthys spilopterus		1		
Paralichthys albigutta		4		
Paralichthys lethostigma		3	2	
Trinectes maculatus		4		
Symphurus plagiusa		6		
Gobiesox strumosus		1		
Alutera schoepfi		1		
Porichthys porosissimum		1		

* One *Galeichthys felis* was taken on hook and line

frequently. These species contributed 86.0 per cent of the total catch. *Poecilia latipinna* was found to be the most abundant species, and the number of this fish represented 23.7 per cent of the total catch. The poeciliids and cyprinodonts were very close in respect to numbers taken, and in terms of abundance these two groups far outnumbered the other families, this being due to their ability to maintain resident breeding populations within the inland marsh area.

Table 5 suggests that families Leiognathidae through Balistidae contributed little to the community. Many of the fishes in these groups (table 6) were considered to be only visitants to the inland waters, gaining entrance via tidal channels and during unusually high storm tides. The majority of these fishes are not known to complete their life histories in brackish marshes, thereby eliminating the establishment of successful breeding populations.

Consideration must be given to the fact that certain species which were taken less frequently and less abundantly may have had an ability to elude capture by seines and nets; also, due to the characteristics of certain stations, desirable collecting procedures were often curtailed.

Length-frequency curves were constructed for several of the more numerous species; however, the curves were of little significance in following the growth of any certain age group and were not presented.

An arrangement of fishes by salinity classes is shown in table 9. The salinity range was divided into sections of 4.9 ppt. each. The number of fishes taken from waters with salinities ranging from 25.0 to 29.9 ppt. far outranked the total number of fishes from any other salinity class. This number represented 38.5 per cent of the total catch. Percentages of the total catch within the other salinity classes were as follows: fresh to 4.9, 5.4 per cent; 5.0 to 9.9, 19.4 per cent; 10.0 to 14.9, 10.1 per cent; 15.0 to 19.9, 4.5 per cent; 20.0 to 24.9, 22.1 per cent. Within all salinity classes the predominant species were members of the Poeciliidae and Cyprinodontidae.

Station 10 was the only area from which sever monthly collections were taken. Station 23 was visited on four occasions; stations 2 and 18 received three visits each; stations 4, 16, and 38 were sampled twice. All other areas were reached only once. Certain environmental factors

TABLE 9

DISTRIBUTION OF FISHES BY SALINITY CLASSES (ppt.)

SPECIES	FRESH--4.9	5.0-9.0	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	SALINITY RANGE	TOTAL NUMBER
Negaprion brevirostris						1	26.0	1
Sphyrna tiburo					1		24.5	1
Dasyatis sabina			2		1		13.3-23.0	3
Lepisosteus oculatus	1						0.6	1
Lepisosteus spatula	12	1		6			0.6-18.0	19
Elops saurus		1			1		7.0-22.7	2
Megalops atlanticus	1				1		1.7-21.5	2
Alosa chrysochloris						1	29.0	1
Dorosoma petenense				1			17.1	1
Harengula pensacolae				3		2	17.1-28.3	5
Anchoa hepsetus				7	15	231	17.1-29.0	253
Anchoa mitchilli		2		1		29	7.0-29.0	32
Synodus foetens					3	2	23.0-28.3	5
Galeichthys felis				4		10	17.1-29.0	14
Strongylura marina					2		23.0-24.5	2
Hyporhamphus unifasciatus						1	27.0	1
Adinia xenica	1	21	23	110	22	32	1.7-26.9	209
Cyprinodon variegatus	233	797	721	422	894	1,456	0.6-29.0	4,532
Fundulus grandis	18	49	17	9	29	24	0.6-29.0	146
Fundulus pulvereus	5	2	1				1.7-12.1	8
Fundulus similis	83	788	413	151	602	1,745	1.7-29.0	3,782
Lucania parva	199	182	4	190	826	595	0.0-27.1	1,996
Gambusia affinis	139	766	440		1,150	2,097	0.0-27.1	4,592
Poecilia latipinna	724	1,220	746	114	1,674	2,304	0.6-29.0	6,782

TABLE 9 (continued)[1]

SPECIES	FRESH—4.9	5.0-9.0	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	SALINITY RANGE	TOTAL NUMBER
Syngnathus louisianae		1			8	1	23.0-28.3	9
Syngnathus scovelli		1			1		7.5-23.0	2
Centropristes philadelphicus		1		1			7.2-18.0	2
Caranx crysos						1	26.0	1
Caranx hippos					1		23.0	1
Caranx latus			1		4		12.1-22.7	5
Chloroscombrus chrysurus		1					9.3	1
Oligoplites saurus						14	28.3	14
Eucinostomus argenteus			1	3	1	78	9.3-29.0	83
Orthopristis chrysopterus					9		23.0	9
Bairdiella chrysura					237		23.0	237
Cynoscion nebulosus		18			22	18	7.5-28.3	58
Larimus fasciatus				7			19.0	7
Leiostomus xanthurus		8	8	4	16	7	5.1-27.0	43
Menticirrhus americanus		3			1	7	8.1-26.1	11
Menticirrhus littoralis		6					7.5	6
Micropogon undulatus		3		5		5	7.5-26.0	13
Sciaenops ocellatus				2			17.1-18.0	2
Stellifer lanceolatus						4	26.0	4
Archosargus probatocephalus				4			17.1-18.0	4
Lagodon rhomboides	1	29	13	6	65	36	2.2-29.0	150
Eleotris pisonis					8		24.8	8
Evorthodus lyricus	2	2			5		2.2-24.8	9
Gobionellus boleosoma		4			2	2	7.0-28.3	8
Gobiosoma bosci		1			1	3	7.0-28.3	5
Microgobius gulosus	8	30	3	10	3	17	2.2-26.1	71

TABLE 9 (continued))

SPECIES	FRESH—4.9	5.0-9.9	10.0-14.9	15.0-19.9	20.0-24.9	25.0-29.9	SALINITY RANGE	TOTAL NUMBER
Prionotus pectoralis		1		1			7.2-18.0	2
Prionotus scitulus				1		2	18.0-28.3	3
Astroscopus y-graecum						1	29.9	1
Hypsoblennius ianthus				1			19.0	1
Lepophidium jeannae					1		20.0	1
Sphyraena barracuda				1			18.9	1
Mugil cephalus	16	345		5	14	41	1.7-27.0	421
Mugil curema	6	39	5	6	12	4	0.6-29.0	72
Membras martinica		3			14	9	9.3-26.0	26
Menidia beryllina	95	1,227	481	203	676	2,194	0.6-29.9	4,876
Etropus crossotus		2		2		3	7.5-27.0	7
Citharichthys spilopterus		1					7.2	1
Paralichthys albigutta					3	1	23.0-28.3	4
Paralichthys lethostigma		1		4			8.1-18.0	5
Trinectes maculatus		1	2			1	8.1-26.4	4
Symphurus plagiusa				1	2	3	18.0-28.3	6
Gobiesox strumosus				1			18.0	1
Alutera schoepfi		1					7.2	1
Potichthys porosissimum						1	26.0	1
TOTALS	1,544	5,557	2,881	1,286	6,327	10,992		

which are given for each station in table 1 may be related to all species collected from the respective areas, also the types of gear by which fishes were taken are presented in table 8.

A discussion of the population composition within the major station categories follows:

1. A large number of specimens was taken from station 10, the **lagoon which is permanently connected to Mississippi Sound,** and the total number of fishes was represented by 38 species and accounted for 23.4 per cent of the total catch. During 1965 samples were obtained in August, September, and November, and during 1966 visits were made in June, July, and August. The November 1965 sample was quite unrepresentative of the area and poor in terms of total catch. This can be accounted for in part due to undesirable weather conditions which hindered collecting procedures. *Fundulus similis, Lagodon rhomboides, and Menidia beryllina* were taken during all collecting months with the exception of November. Of these species only *Menidia beryllina* appeared in the November sample; however, the validity of this sample for the purposes of comparison has previously been mentioned. Five species, *Anchoa hepsetus, Cynoscion nebulosus, Cyprinodon variegatus, Gambusia affinis,* and *Poecilia latipinna,* appeared in the majority of monthly samples.

In June several species which were not encountered during other months of sampling at station 10 were collected. The list was comprised of *Caranx hippos, Bairdiella chrysura, Orthopristis chrysopterus,* and *Syngnathus scovelli.* During the period of collecting the temperature of the water ranged from 25.1 to 26.0° C., and the salinity was 23.0 ppt. Only during the month of July were *Caranx crysos, Micropogon undulatus, Negaprion brevirostris, Porichthys porosissimum,* and *Stellifer lanceolatus* collected. Water temperatures ranged from 27.0 to 28.0° C., and the salinity was 26.0 ppt. during that month. *Harengula pensacolae, Prionotus scitulus, Sphyrna tiburo,* and *Symphurus plagiusa* were taken only in August. The temperature of the water at this time ranged from 28.9 to 30.0° C., and the salinity was 24.5 ppt. One species, *Galeichthys felis,* which is common in the waters of Mississippi Sound appeared only in September; the temperature range was 28.2 to 28.9° C., and the salinity was 29.0 ppt. During the November collecting period at station 10, water temperatures ranged from 18.4 to 19.0° C., and

6. Two species, *Gambusia affinis* and *Lucania parva* were the only fishes taken from rainwater ponds. The number of these fishes accounted for 0.21 per cent of the total catch.

SUMMARY

An investigation of the fish population within the inland waters of Horn Island, Mississippi was made from August 1965 to September 1966. The objective of the study was to ascertain what species compose the fish population and their relative abundance.

Horn Island is a member of the chain of barrier islands which is associated with Mississippi Sound. The island is bordered by Horn Island Pass to the east and Dog Keys Pass to the west, and lies with its center in Latitude 30^0 14' and Longitude 88^0 40'. The island is some twelve miles long and is approximately three-fourths mile across at the widest point.

Forty-nine collecting stations were established, and these were categorized as being either a lagoon, pond, pool, or ditch. One lagoon was permanently connected with Mississippi Sound, while other lagoons, ponds, pools, and ditches were temporarily influenced by waters of the Sound.

During severe storm conditions landlocked areas are often flooded by elevated seas. Small pools are occasionally created at such times. Heavy rainfall accounts for the presence of temporary freshwater pools. The majority of areas are shallow, and several support submerged aquatics. The greater number of sampled areas have bottoms which are composed of mud and some sand, and when disturbed during collecting activities the water becomes rather murky.

A salinity range from fresh to 29.9 ppt. was noted for the sampled bodies of water. No hypersaline waters were encountered. In several areas an influx of fresh water, resulting either from rainfall or flowing artesian wells, was considered a compensatory factor when reflecting upon the effects of evaporation. The highest salinity readings were noted for areas which were influenced by the waters of Mississippi Sound during high tide.

Water temperatures ranged from 14.1 to 33.5°C. The lowest and highest readings were recorded in December and July, respectively.

During the course of the study 28,587 specimens were collected in 194 hauls. The total catch included 69 species representing 58 genera and 35 families. Fishes were collected in trammel nets, seines, a cast net, and a brail net, and were preserved in 10 per cent formalin. All specimens were identified, counted, measured, and weighed.

The waters investigated were populated by both marine and brackish water fishes. Several euryhaline species were taken from both fresh water and water which was approaching fresh; however, no true fresh water fishes were obtained.

Cyprinodon variegatus, Fundulus similis, Gambusia affinis, Menidia beryllina, and *Poecilia latipinna* were taken in large numbers and were the most frequently encountered species. Their numbers formed 86.0 per cent of the total catch. Of these fishes *Poecilia latipinna* was the most abundant and represented 23.7 per cent of the catch.

The greater number of species taken during the course of the investigation were not known to complete their life histories in areas such as those examined and, therefore, were not considered to be permanent residents. The killifishes and poeciliids were capable of completing their life histories in the majority of areas examined and, due to their established resident breeding populations, contribute most to the permanent occupancy of the inland waters of Horn Island.

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Observations on *Claviceps purpurea* on *Spartina alterniflora* in the Coastal Marshes of Mississippi

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Observations on *Claviceps purpurea* on *Spartina alterniflora* in the Coastal Marshes of Mississippi [1]

by

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Seventy-five years ago the first report of the occurrence of *Claviceps purpurea* (Fr.) Tul. on *Spartina alterniflora* Loisel in Mississippi was made by Tracy and Earle (1895). Collections were taken at Ocean Springs, Mississippi on Christmas Day in 1892. These specimens are in the herbarium of the Department of Plant Pathology at Mississippi State University. Tracy and Earle presented no data on the infection rate nor does collection data indicate widespread infection. Parris (1959) published a revised host index of Mississippi plant diseases in which he listed *C. purpurea* based on the collections by Tracy and Earle. No further reports have been made of the parasite in this area of the Gulf Coast.

The fungus, *C. purpurea*, commonly known as ergot, was observed, collected and studied on *S. alterniflora* (smooth cord grass, oyster grass) in the tidal marshes of Mississippi during the late summer and fall of 1968. Collections taken by the author have been deposited at Mississippi State University, the United States Department of Agriculture, Agriculture Research Service at Beltsville, Maryland, and the herbarium of the Gulf Coast Research Laboratory.

In the present study list-count quadrats were used to obtain data on the intensity of infection. A one-half by two meter rectangular frame was placed out at random in three *S. alterniflora* habitats in Mississippi; these habitats were located on the east beach of Ocean Springs, Davis

[1] This study was conducted in cooperation with the Department of Interior, Bureau of Commercial Fisheries, under Public Law 88-309, Project 2-25-R.

Bayou and at Graveline Bayou. Three quadrat samples were made per habitat. All mature culms present were producing seed. Counts of infected and uninfected panicles were made. *C. purpurea* was present on 96.5% of the mature *S. alterniflora* culms (Figure 1). The panicles occurring in the quadrats were clipped and placed in envelopes and labeled. Sclerotia were observed growing from the seed embryos. Counts of the infected and uninfected seeds per panicle were obtained. Seventy-one percent of the seed produced on infected panicles bore sclerotia. The number of seeds per panicle ranged from 147 to 561 and averaged 274 seeds. The length of the sclerotia at maturity ranged from 9 to 33 mm and averaged 14.5 mm. The diameter of the sclerotia ranged from .5 mm to 1 mm and averaged .86 mm (Figure 2). Conidia accompanied early sclerotia development (Engler 1896). These conidia were characteristically mixed in a thick sweet, nectar-like secretion. It has been reported that, attracted by this nectar, insects visiting the infected ovaries distribute the conidia to uninfected flowers, spreading the fungus in this way (Alexopoulos 1964). The conidia have been maintained in culture for future work (Lewis 1959). Seeds were considered infected if visible signs of infection such as sclerotia were present. Based on this data, it is estimated that the fungus reduced the total potential production of viable seed by 68.5% during 1968. Unseen infection or damage to the seed embryo was not investigated. Therefore, the viable seeds reduction was probably even greater. Whether the heavy infection is a common seasonal occurence is not known. However, if the heavy infection is common then the reproductive ability of *S. alterniflora* is greatly affected by reducing the number of viable seeds produced each year. The number of seeds produced per square meter was 8496. Therefore 34,375,016 seeds which weigh approximately 16.7 lbs. are produced per acre. The loss of 68.5% or more of this production may have considerable impact on estuarine fish and wildlife resources. Schelshe and Odum (1961) pointed out that the estuaries and specifically tidal marshes are among the most productive natural ecosystems in the world. The primary production of *S. alterniflora* was determined to be 2,000 gr. of dry organic matter /m^2 or 10 tons of dry organic matter per acre per year. Any factor which affects the plant population of *S. alterniflora* would greatly affect the estuarine system and ultimately the economically important food organisms of man.

The fungus was observed to occur on *S. alterniflora* over a range of approximately 120 miles along the Gulf Coast which included the

Figure 1.

Figure 2.

Figure 1. *Claviceps purpurea* parasitizing seeds in the panicles of *Spartina alterniflora*. Arrow (←) indicates an infected panicle.

Figure 2. Close up view of the sclerotia of *C[illegible]purpurea* extending from the seeds of *Spartina alterniflora*. Arrow (←) indicates one sclerotium.

Mississippi, Alabama and 30 miles of the Louisiana Coast. *S. alterniflora* was not observed in the Pensacola, Florida area, including Pensacola Bay. Observations in the Louisiana marshes were made only as far as the Rigolets and Lake Borgne area. *C. purpurea* was found at all points of observation where *S. alterniflora* was present. However, the rate or intensity of infection varied. The intensity of infection was not measured by quadrat in Alabama or Louisiana, but the general effect and intensity of infection were easily observable. The infection was not as intense in Alabama or Louisiana as in Mississippi.

The range of *S. alterniflora* and its pattern of distribution along the Gulf Coast is not presently known. The absence of *S. alterniflora at* Pensacola indicates a disjunct distribution.

C. purpurea has been reported on two other plant species in Mississippi, salt grass, *Distichilis spicata* and *Tripsacum dactyloides* (Parris 1959). Unidentified species of *Claviceps* have been reported to occur on *Anthaenantia rufa, Panicum virgatum, Andropogon sp.,* and *Paspalum sp.,* all of which are upland species. *P. virgatum* is present in low salinity marshes. None of these species have been observed with *C. purpurea* infection in Mississippi.

In established stands, *S. alterniflora* is capable of vegetative reproduction by growth of rhizomes and expands to occupy adjacent suitable environment. The ability to establish natural new stands in suitable environment would depend on viable seed or the transfer of rhizomes eroded from established areas. I have observed that uninfected *S. alterniflora* seed do germinate and that seedlings grow vigorously whenever seeds are buried in a suitable drift line area on the beaches and in the marshes of Mississippi.

Rapidly increasing industrial development along the Mississippi Gulf Coast and the resulting dredging and filling operations threaten to reduce estuarine production of fish and wildlife resources. Spoil areas in open water usually erode to or near surface levels and remain barren. Winnowing leaves a relatively high energy sand area that is not productive. The importance of rapid establishment of *S. alterniflora* on some spoil areas has been pointed out by Chapman (1967). Experiments were carried out with transplanted rhizomes. Preliminary studies at the Gulf Coast Research Laboratory indicate that seeding may be more

efficient and economical. Consequently, the recurrence and spread of heavy *C. purpurea* infections may have serious effects on the estuarine environment.

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Fishes Rarely Caught in Shrimp Trawl

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Fishes Rarely Caught in Shrimp Trawl.

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During a three year study made of the offshore waters of Mississippi the author became interested in the fishes "rarely caught" in shrimp trawls. This report concerns all data for the project, which was carried out during 1967, 1968 and 1969. The only characteristic common to the following species is the rarity with which they are taken in regular shrimp trawling operations. Some are by no means rare in terms of total number available in the Gulf of Mexico, but it is worthwhile to report data collected as compared to others taken thirty-nine to forty-one years ago in nearby Louisiana. (Gunter, 1935). Later Gunter (1941) listed certain rare fishes from Texas taken in both inside and outside waters. The data given here concern only offshore stations, which extended farther out than any previously reported from this coast.

A series of stations was set with the inner one at the sea buoy just beyond Dog Keys Pass. The buoy is in 6 fathoms of water and is located 2½ miles southwest of the south end of Horn Island in the open Gulf. The stations were set on a south SE course at ten fathom intervals to the fifty fathom curve. The vessel used during the survey was the *Gulf Researcher.*

A 40 foot trawl of one and five-eighths inches stretched mesh was pulled for a 30 minute period at three miles per hour. At each station, bottom salinity and temperature determinations were made. The shrimp trawl is designed for bottom fishing. The trawl generally closes going down and coming up. Other gear are devised for mid-water fishing.

The location and depth of each station by latitude and longitude are:

Station 1, 6 fms, 30° 13′ 15″ N, 88° 47′ 30″ W
Station 2, 10 fms, 30° 02′ 30″ N, 88° 40′ 15″ W

Station 3, 20 fms, 29° 42′ 00″ N, 88° 27′ 30″ W
Station 4, 30 fms, 29° 24′ 15″ N, 88° 17′ 00″ W
Station 5, 40 fms, 29° 19′ 00″ N, 88° 14′ 00″ W
Station 6, 50 fms, 29° 15′ 00″ N, 88° 11′ 30″ W

DISCUSSION

Two hundred and thirty-nine trawl hauls produced in three years (1967, 68, 69) 93,703 specimens of 135 species. Two hundred and fifty-seven specimens comprised of eighty-eight species represented 0.27 per cent of the total. D and N in Table 1 represent day and night catches of these 257 specimens. One hundred and fifty-seven specimens, representing 61 percent of the total, were the day catches and one hundred specimens, 39 per cent, were night catches. They are made up of species caught in numbers of ten or less per species.

During day trawls, 69 species comprised of 157 specimens were taken from 138 hauls. In terms of specimens per haul these data may be broken down as follows: 1.14 specimens were taken in each trawl or 0.5 species per haul.

Similarly since 52 species (100 specimens) were taken in 101 night trawls, the breakdown shows that 0.99 specimens were obtained from each haul or 0.51 species per haul. There was not much difference between the number of fishes rarely caught between day and night.

In all the catches 88 species made up 0.27 per cent, whereas 48 species made up 99.73 per cent of the total.

The majority of specimens were measured in both standard and total length on a measuring board. Standard lengths (from the tip of the snout to the posterior edge of the hypural plate) were taken with few exceptions on all fishes collected. All measurements were recorded in mm and the figures given are for total length. The majority of fishes were dried by blotting, and weight determinations were made by means of a top loading precision Mettler balance. Specimens were identified by the author, and several are deposited in the Gulf Coast Research Laboratory museum.

TABLE 1

SPECIES	DATE	Total Wgt. G.	Wgt. Ave. per Species	Total
Mustelus canis	Mar. 67 D. 6	4082.3	2041.4	2
	Mar. 68 D. 6	4560.0	4560.0	1
Scoliodon terraenovae	Aug. 67 D. 6	986.6	986.6	1
	Jan. 68 N. 3	3900.9	3900.9	1
Sphyrna tiburo	Mar. 67 D. 2	1299.0	433.0	3
	Nov. 67 D. 2	299.9	299.9	1
	Mar. 69 D. 1	297.1	297.1	1
	Mar. 69 D. 2	298.8	298.8	1
Squatina dumerili	Mar. 67 D. 6	407.2	407.2	1
	Mar. 68 D. 6	2880.0	2880.0	1
	Jan. 69 D. 6	13608.0	6804.0	2
	Mar. 69 D. 6	343.3	343.3	1
Narcine brasiliensis	Dec. 68 D. 4	453.6	453.6	1
Raja eglanteria	Aug. 67 D. 4	385.3	385.3	1
	Apr. 69 N. 1	1144.0	1144.0	1
Raja texana	May 67 D. 4	455.5	455.5	1
	Jul. 67 D. 4	463.4	463.4	1
	Jul. 67 D. 6	398.2	398.2	1
	Jul. 67 D. 5	425.0	425.5	1
	July. 68 D. 3	598.3	598.3	1
	Dec. 68 D. 3	175.9	175.9	1
	Jun. 68 N. 5	365.7	365.7	1
	May 68 D. 6	429.6	429.6	1
Dasyatis americanus	Feb. 69 D. 5	37648.8	37648.8	1
Dasyatis sayi	Mar. 67 D. 2	1542.2	1542.2	1
Alosa chrysochloris	May 69 N. 1	17.9	17.9	1
Brevoortia patronus	Nov. 68 D. 1	141.3	141.3	1
	Jan. 69 N. 1	77.7	38.8	2
Etrumeus sadina	Apr. 69 D. 2	11.0	3.6	3
Harengula pensacolae	Nov. 67 D. 3	69.2	34.6	2
Opisthonema oglinum	Jan 68 D 1	35.2	35.2	1
	Apr. 69 D. 1	13.5	13.5	1
	Apr. 69 D. 2	22.4	22.4	1
Anchoa hepsetus	Aug. 67 D. 6	18.3	9.1	2
Saurida brasiliensis	Apr. 69 N. 3	17.4	17.4	1
Trachinocephalus myops	Feb. 67 N. 4	113.5	113.5	1
	Jun. 67 N. 4	45.3	45.3	1
	May 67 N. 5	52.0	52.0	1
	Oct. 68 N. 4	127.5	637.5	2
	Nov. 68 N. 4	148.6	148.6	1
	Jul. 68 D. 5	147.9	739.5	2
	Apr. 69 D. 5	85.8	85.8	1
Bagre marinus	Feb. 69 N. 1	46.3	46.3	1
Anguilla rostrata	Nov. 67 D. 2	72.1	72.1	1
	May 68 N. 2	71.3	71.3	1
	May 68 N. 3	73.1	73.1	1
	Jan. 68 D. 4	144.3	144.3	1
	Mar. 68 D. 6	97.8	97.8	1
	Feb. 69 N. 3	98.3	98.3	1

TABLE 1
(continued)

SPECIES	DATE	Total Wgt. G.	Wgt. Ave. per Special	Total
Gymnothorax nigromarginatus	Mar. 67 N. 3	298.0	149.1	2
	Oct. 67 N. 3	103.2	103.2	1
	May 67 D. 5	122.4	122.4	1
Congrina flava	Nov. 68 D. 3	67.0	67.0	1
	Jan. 68 D. 4	5.2	5.2	1
	Oct. 68 D. 6	101.5	101.5	1
Hoplunnis macrurus	Jun. 67 N. 6	24.9	24.9	1
	Mar. 69 N. 6	25.0	25.0	1
	Mar. 69 N. 4	7.6	7.6	1
	Jan. 69 N. 3	7.5	7.5	1
Ophichthus ocellatus	Mar. 69 D. 5	86.5	86.5	1
Urophycis regius	Apr. 67 D. 2	52.0	15.5	4
Zenopsis ocellata	Oct. 68 D. 6	150.7	150.7	1
Serranus notospilus	Mar. 67 D. 6	27.2	6.8	4
Serranus atrobranchus	Aug. 67 D. 4	26.8	13.4	2
	Jul. 67 N. 4	13.0	13.0	1
	Jul. 67 N. 5	24.7	24.7	1
Pristipomoides andersoni	May 67 D. 6	66.6	66.6	1
	Jun. 67 N. 4	267.8	267.8	1
	Feb. 69 D. 6	111.5	111.5	1
Priacanthus arenatus	Jul. 67 D. 5	51.8	51.8	1
	Sept. 68 D. 6	69.5	69.5	1
	Mar. 69 N. 6	124.5	124.5	1
	May 69 D. 6	36.6	36.6	1
Pomatomus saltatrix	Jan. 68 D. 1	17.0	17.0	1
	Sept. 68 D. 4	335.5	335.5	1
	Sept. 68 D. 5	430.7	430.7	1
Rachycentron canadum	Jan. 68 D. 4	730.2	730.2	1
Chloroscombrus chrysurus	Oct. 67 N. 3	30.2	30.2	1
	Nov. 67 D. 3	39.8	39.8	1
	Apr. 69 D. 4	61.2	61.2	1
Selar crumenophthalmus	May 68 D. 6	111.5	111.5	1
Vomer setapinnis	Dec. 68 D. 2	11.4	11.4	1
	Jun. 68 D. 4	138.0	138.0	1
Eucinostomus argenteus	Feb. 69 N. 4	40.8	40.8	1
Cynoscion nothus	Mar. 67 D. 5	298.3	149.1	2
	Jan. 67 D. 2	5.3	5.3	1
Equetus acuminatus	Mar. 69 N. 4	28.7	28.7	1
	Mar. 69 D. 4	172.9	576.3	3
	Apr. 69 N. 4	31.3	31.3	1
Larimus fasciatus	Nov. 67 D. 2	304.4	76.1	4
	Sept. 67 D. 2	40.8	40.8	1
Menticirrhus americanus	Jan. 67 N. 2	122.9	61.4	2
	Aug. 67 N. 2	121.9	121.9	1
	Sept. 67 N. 2	91.5	91.5	1
Pogonias cromis	Nov. 67 D. 1	4309.1	4309.1	1

TABLE 1
(continued)

SPECIED	DATE	Total Wgt. G.	Wgt. Ave. per Species	Total
	Mar. 69 D. 2	2041.2	2041.2	1
	Jan. 69 N. 5	3402.0	3402.0	1
Mullus auratus	Mar. 67 D. 6	57.8	57.8	1
Archosargus probatocephalus	Jan 67 N. 2	4536.0	4356.0	1
	Jan. 69 N. 3	1134.0	1134.0	1
Lagodon rhomboides	Jan. 67 N. 3	106.0	53.0	2
Pagrus sedicem	Mar. 67 D. 6	978.1	489.0	2
Chaetodipterus faber	Mar. 67 N. 31	214.6	107.3	2
	Feb. 67 D. 3	195.2	97.6	2
	Oct. 67 N. 3	59.6	59.6	1
Scomber colias	Mar. 69 N. 5	86.5	86.5	1
Scomberomorus maculatus	Sept. 67 D. 2	257.8	128.9	2
	Oct. 68 D. 2	76.8	38.4	2
	Nov. 68 N. 2	134.4	134.4	1
Bollmania communis	Mar. 67 N. 3	2.9	2.9	1
	Aug. 67 N. 3	11.8	3.8	3
	Jun. 68 D. 1	5.9	5.9	1
Neomerinthe pollux	May 67 N. 6	453.6	453.6	1
Scorpaena calcarata	Aug. 67 D. 6	13.4	13.4	1
Bellator militaris	Nov. 67 D. 5	33.5	33.5	1
	July 67 D. 6	12.7	12.7	1
Peristedion gracile	Mar. 67 D. 6	107.7	35.9	3
	Mar. 67 D. 5	54.9	27.4	2
Prionotus alatus	Mar. 67 D. 6	45.3	15.1	3
Prionotus ophryas	Mar. 67 D. 6	57.8	57.8	1
Prionotus roseus	Nov. 67 D. 4	54.1	54.1	1
Prionotus scitulus	Aug. 67 N. 5	18.8	18.8	1
Prionotus stearnsi	May 67 D. 6	35.2	11.7	3
	Nov. 67 D. 3	5.3	5.3	2
	Nov. 68 D. 3	15.7	15.7	1
	Dec. 68 D. 3	17.9	17.9	1
	Sept. 68 D. 6	30.4	30.4	1
Astroscopus y-graecum	Jan. 68 N. 1	152.9	152.9	1
Kathetostoma albigutta	Aug. 67 N. 5	30.8	30.8	1
	Jun. 67 D. 5	79.2	79.2	1
	July 67 N. 5	30.7	30.7	1
	July 68 D 5	28.8	28.8	1
	Oct. 68 D. 5	37.8	37.8	1
	Oct. 68 D. 5	51.7	51.7	1
Bregmaceros atlanticus	Mar. 67 D. 6	1.6	0.8	2
Brotula barbata	Jan. 67 N. 3	64.2	64.2	1
	Oct. 67 N. 3	61.0	61.0	1
	Oct. 67 N. 6	75.7	75.7	1
	Jul. 67 D. 6	177.9	177.9	1
Lepophidium graellsi	Jul. 67 N. 5	101.6	50.8	2
Ophidion welshi	Feb. 69 N. 1	41.1	41.1	1

TABLE 1
(continued)

SPECIES	DATE	Total Wgt. G.	Wgt. Ave. per Species	Total
	Feb. 69 N. 2	39.2	39.2	1
	May 69 D. 2	7.9	7.9	1
Peprilus paru	Mar. 67 N. 3	63.8	63.8	1
	Jan. 68 N. 1	14.6	14.6	1
	Jan. 68 D. 1	41.3	41.3	1
Sphyraena guachancho	Dec. 68 N. 1	167.7	167.7	1
	Mar. 68 N. 2	53.5	53.5	1
	Mar. 68 D. 5	160.0	160.0	1
	Nov. 67 D. 4	19.3	19.3	1
Mugil cephalus	Nov. 68 D. 3	375.1	375.1	1
Ancyclopsetta dilecta	Mar. 67 D. 5	129.2	129.2	1
	May 69 N. 6	43.5	43.5	1
Ancylopsetta quadrocellata	Mar. 67 N. 3	150.6	150.6	1
Citharichthys macrops	Jun. 67 N. 2	121.6	30.4	4
Citharichthys spilopterus	Jul. 67 D. 3	34.2	17.1	2
	Mar. 67 N. 3	29.8	29.8	1
Engyophrys sentus	Mar. 68 D. 3	3.1	3.1	1
	Nov. 68 D. 5	7.6	7.6	1
Etropus crossotus	Mar. 67 D. 5	7.7	7.7	1
	May 67 N. 5	5.2	5.2	1
Paralichthys lethostigma	Mar. 67 N	188.1	188.1	1
	May 67 D. 3	514.0	514.0	1
	Jun. 67 D. 3	251.0	251.0	1
	Aug. 67 N. 3	269.8	269.8	1
	May 67 D. 6	551.0	551.0	1
	Feb. 69 D. 1	330.8	165.4	2
Paralichthys squamilentus	Mar. 67 D. 6	1620.0	810.0	2
	Jan. 69 D. 4	167.8	167.8	1
	Apr. 69 N. 4	200.9	200.9	1
	Jan. 69 N. 5	73.4	73.4	1
Syacium gunteri	Mar. 67 D. 6	176.9	176.9	1
	Jun. 67 D. 6	93.7	93.7	1
Syacium papillosum	Nov. 68 D. 4	34.6	17.3	2
Gymnachirus texae	July 67 N. 2	15.8	7.9	2
	Aug. 67 D. 2	18.3	9.1	2
	May 67 D. 4	17.3	17.3	1
Gymnachirus melas	Mar. 68 D. 5	44.0	44.0	1
Symphurus diomedianus	Jan. 67 N. 3	27.4	27.4	1
	Mar. 67 D. 6	25.1	25.1	1
Symphurus plagiusa	Aug. 67 D. 5	36.2	36.2	1
Echeneis naucrates	Mar. 67 N. 4	230.5	230.5	1
Alutera scripta	July 67 D. 6	12.6	12.6	1
	Aug. 67 D. 6	16.3	16.3	1
	Oct. 67 N. 6	15.8	15.8	1
	Jul. 67 D. 2	12.1	12.1	1
	Mar. 67 N. 3	10.8	10.8	1

TABLE 1
(continued)

SPECIES	DATE	Total Wgt. G.	Wgt. Ave. per Species	Total
Balistes capriscus	Nov. 67 D. 3	85.0	85.0	1
	Mar. 67 N. 4	46.7	46.7	1
Monacanthus hispidus	Feb. 67 N. 4	113.5	113.5	1
	Jan. 69 N. 4	57.6	28.8	2
	Mar. 69 D. 4	47.7	47.7	1
	Apr. 69 N. 4	32.5	32.5	1
Lagocephalus laevigatus	Apr. 69 N. 4	29.1	29.1	1
	Jan. 69 N. 5	45.1	45.1	1
Chilomycterus schoepfi	Jan. 69 N. 1	7.7	7.7	1
	May 69 D. 2	134.8	134.8	1
Antennarius radiosus	May 69 D. 2	7.0	3.5	2
	May 69 D. 3	22.9	22.9	1
	May 69 D. 3	25.8	25.8	1
	Apr. 69 D. 5	23.1	23.1	1
Ogcocephalus parvus	Mar. 67 D. 5	8.2	8.2	1

None of the elasmobranchs reported are known to be greatly abundant anywhere on the northern Gulf Coast.

In contrast *Chloroscombrus chrysurus, Cynoscion nothus, Anchoa hepsetus, Pogonias cromis, Menticirrhus americanus, Archosargus probatocephalus, Harengula pensacolae, Citharichthys spilopterus, Etropus crossotus, Paralichthys lethostigma,* and *Symphurus plagiusa* are quite common nearer shore and in bay waters. The Spanish mackerel, *Scomberomorus,* is sometimes present in vast schools from spring to fall, but it is mostly a pelagic fish and is seldom taken in trawls. Eels and other thin fishes are not often taken in trawls.

Many of the other fishes taken are slow moving bottom species and many of them are probably relatively uncommon off the Mississippi coast.

Data on Specimens Rarely Caught

Mustelus canis (Mitchell)
1967 – Two smooth dogfish (690-825 mm) were taken on March 15 from the 50 fathom station. The salinity was 33.8 parts per thousand and the bottom temperature was 20.2 C.
1968 – One smooth dogfish (974 mm) was taken on March 27 from the 50 fathom station. The salinity was 34.6 parts per thousand and the bottom temperature was 15.3 C.

Scoliodon terraenovae (Richardson)
1967 – One (633 mm) specimen was taken at 50 fathoms on August 9 (salinity 36.8, temperature 25.1).
1968 – One (959 mm) specimen was taken at 50 fathoms on January (salinity 30.5, temperature 18.4).

Sphyrna tiburo (Linnaeus)
1967 – A total of four bonnetheads (400-462 mm) were taken during this study from the 10 fathom station, three in March and one in November (salinity 34.2 and temperature 14.6 on March 21; on November 14 salinity 36.8 and temperature 20.3).
1969 – Two bonnetheads (413-416 mm) were taken, one from 10 fathoms on March 23 (salinity 32.4, temperature 15.0) and one March 23 from 6 fathoms (salinity 30.7, temperature 15.2).

Squatina dumerili LeSueur
1967 – One large (360 mm) specimen was taken from 50 fathoms on March 15 (salinity 33.8, temperature 20.0).
1968 – A single (646 mm) specimen was taken on March 27 from the 50 fathom station (salinity 34.6, temperature 15.3).
1969 – Three Atlantic angel sharks (375-898 mm) were taken, two from the 50 fathom station on January 23 (salinity 36.5, temperature 16.8), and one from the 50 fathom station on March 22 (salinity 36.5, temperature 17.2).

Narcine brasiliensis (Olfers)
1968 – One (367 mm) lesser electric skate was taken on December 10 from the 30 fathom station (salinity 31.8, temperature 21.8).

Raja eglanteria Bosc
1967 – One (400 mm) specimen was taken from the 30 fathom station on August 30 (salinity 37.1, temperature 25.5).
1969 – One (554 mm) clearnose skate was taken from the 6 fathom station on April 30 (salinity 34.9, temperature 19.5)

Raja texana Chandler
1967 – Four specimens (438-515 mm) were taken from 30 fathoms, 40 fathoms, 50 fathoms, and 30 fathoms during four hauls (May 24 salinity 36.4, temperature 22.0; July 12 salinity 37.0, temperature 25.1; July 25 salinity 36.6, temperature 20.5; July 25 salinity 37.0, temperature 24.6).
1968 – Four specimens (323-441 mm) were taken, two from the 20 fathom, and one each from 40 fathom and 50 fathom stations (December 10 salinity 35.7, temperature 17.5; July 30 salinity 29.8, temperature 26.5; May 21 salinity 27.0, temperature 20.5).

Dasyatis americana Hildebrand and Schroeder
1969 – One southern stingray (1935 mm) was taken on February 27 from the 40 fathom station (salinity 33.5, temperature 16.9).

Dasyatis sayi (Le Sueur)
1967 - A single (664 mm) specimen was taken on March 2 from 10 fathoms (salinity 34.2, temperature 14.6).

Alosa chrysochloris (Rafinesque)
1969 – One (136 mm) skipjack herring was taken on May 15 from the 6 fathom station (salinity 24.9, temperature 22.0).

Brevoortia patronus Goode

1968 – One Gulf menhaden (180 mm) was taken from the 6 fathom station on November 20 (salinity 36.5, temperature 16.4).
1969 – Two (132-162 mm) menhaden were taken on January 23 from the 6 fathom station (salinity 32.1, temperature 14.1).

Estrumeus sadina (Mitchell)

1969 – Three Atlantic round herring (84-87 mm) were taken on April 29 from the 10 fathom station (salinity 35.7, temperature 19.6).

Harengula pensacolae Goode and Bean

1967 – Two scaled sardines (116-118 mm) were caught on November 14 from the 20 fathom station (salinity 36.8, temperature 20.3).

Opisthonema oglinum (LeSueur)

1968 – One (143 mm) specimen was taken at 6 fathoms on January 29 (salinity 28.5, temperature 14.8).
1969 – Two Atlantic thread herring (113-135 mm) were taken, one from the 6 fathom station on April 29 (salinity 32.4, temperature 20.9), and one from the 10 fathom station on April 29.(salinity 35.7, temperature 19.6).

Anchoa hepsetus (Linnaeus)

1967 – Two specimens (72 and 105 mm) were taken at 50 fathoms on August 9 (salinity 36.8, temperature 25.1).

Saurida brasiliensis Norman

1969 - One (133 mm) specimen was taken on April 29 from the 20 fathom station (salinity 39.8, temperature 17.8).

Trachinocephalus myops (Foster)

1967 – Three snakefishes (177 – 300 mm) were caught. Two were from the 30 fathom station, one on June 21 (salinity 36.8, temperature 20.4), and the other on February 22 (salinity 35.6, temperature 16.4). One from the 50 fathom station was taken on May 24 (salinity 36.7, temperature 18.8).
1968 – Five snakefish (190-252 mm) were caught, including two from the 30 fathom station on October 9 (salinity 26.5, temperature 21.7), two from the 40 fathom station on July 25 (salinity 23.2, temperature 19.2), and one from the 30 fathom station on November 13 (salinity 37.3, temperature 20.8).

1969 – One (218 mm) snakefish was taken from the 40 fathom station on April 30 (salinity 34.4, temperature 18.4).

Bagre marinus (Mitchill)

1969 – One (191 mm) was taken on February 13 from the 6 fathom station (salinity 31.5, temperature 14.0).

Anguilla rostrata (LeSueur)

1967 – A single (409 mm) specimen was taken at the 10 fathom station on November 14 (salinity 36.8, temperature 20.3).

1968 – Four American eels were taken (378-495 mm). One was from the 10 fathom station on May 28 (salinity 34.4, temperature 20.3), one from the 20 fathom station on May 20 (salinity 34.4, temperature 22.0), one from 30 fathoms on January 17 (salinity 33.0, temperature 15.2), and one from 50 fathoms on March 27 (salinity 34.6, temperature 15.3).

1969 – One (445 mm) American eel was taken from the 20 fathom station on February 27 (salinity 30.1, temperature 15.1).

Gymnothorax nigromarginatus (Girard)

1967 – A total of four blackedge morays (390-427 mm) were caught. They were taken in the months of March, May and October. Two were from the 20 fathom station, one on March 21 (salinity 36.1, temperature 17.8), and one on October 27 (salinity 34.9, temperature 20.3). The other two came from the 40 fathom station on May 17 (salinity 35.5, temperature 20.2).

Congrina flava (Goode and Bean)

1968 – Three yellow congers (196-414 mm) were taken, one from the 50 fathom station on October 9 (salinity 27.9, temperature 19.3), one from the 30 fathom station on January 17 (salinity 33.0, temperature 15.2), and one from the 20 fathom station on November 13 (salinity 37.3, temperature 15.2).

Hoplunnis macrurus Ginsburg

1967 – One (447 mm) silver conger was caught from the 50 fathom station on June 27 (salinity 35.4, temperature 18.3).

1969 – Three silver congers (226-333 mm) were taken, one on January 14 from the 20 fathom station (salinity 43.1, temperature 16.7), one on March 21 from the 30 fathom station (salinity 35.7, temperature 16.9), and one on May 29 from the 50 fathom station (salinity 19.9,

temperature 20.5).

Ophichthus ocellatus (LeSueur)
1969 – One palespotted eel (6 ft.) was taken on March 22 from the 40 fathom station (salinity 35.7, temperature 16.4).

Urophycis regius (Walbaum)
1967 – Four spotted hake (98-131 mm) were caught in one haul from the 10 fathom station on April 18 (salinity 34.8, temperature 20.5).

Zenopsis ocellata (Storer)
1968 – One American John Dory (198 mm) was taken from the 50 fathom station on October 9 (salinity 26.5, temperature 21.8).

Serranus notospilus (Longley)
1967 – Four examples (72-93 mm) were secured in one haul from the 50 fathom station on March 15 (salinity 33.8, temperature 20.0).

Serranus atrobranchus (Cuvier)
1967 – Four specimens (69-119 mm) were taken, two from 20 fathoms on August 8 (salinity 37.1, temperature 25.2), one from the 40 fathom station on July 12 (salinity 37.0, temperature 25.1), and one from the 30 fathom station on July 25 (salinity 36.0, temperature 25.2).

Pristipomoides andersoni Ginsburg
1967 – Two wenchmen (177-267 mm) were taken on May 21 from the 50 fathom station (salinity 36.4, temperature 20.5). Another one was taken from the 30 fathom station on June 21 (salinity 36.8, temperature 20.4).
1969 - One (221 mm) wenchman was taken on February 27 from the 50 fathom station (salinity 34.6, temperature 16.6).

Priacanthus arenatus Cuvier
1967 – One (146 mm) bigeye was taken in the Gulf on July 25 at the 40 fathom station (salinity 37.2, temperature 20.6).
1968 – One bigeye (185 mm) was taken from the 50 fathom station on September 25 (salinity 37.3, temperature 18.9).
1969 – Two bigeye (148-215 mm) were taken, one on March 21 from the 50 fathom station (salinity 36.5, temperature 16.4), and one on May 26 from the 50 fathom station (salinity 36.5, temperature 18.2).

Pomatomus saltatrix (Linnaeus)
1968 – Three bluefish (123-346 mm) were taken, one from 6 fathoms on January 29 (salinity 28.5, temperature 14.8), one from the 30 fathom station on September 25 (salinity 36.5, temperature 21.0), and one from the 40 fathom station on September 25 (salinity 24.9, temperature 19.3).

Rachycentron canadum (Linnaeus)
1968 – One (510 mm) cobia was taken on January 17 from the 30 fathom station (salinity 33.0, temperature 15.2).

Chloroscombrus chrysurus (Linnaeus)
1967 – Two specimens (153-180 mm) were taken from the 20 fathom station on October 27 and November 14 (salinity 36.8 - 35.4, temperature 20.3 - 19.5, respectively).
1969 – One bumper (196 mm) was taken on April 30 from the 30 fathom station (salinity 37.4, temperature 18.2).

Selar crumenophthalmus (Bloch)
1968 - One (212 mm) bigeye scad was taken from the 50 fathom station on May 21 (salinity 27.0, temperature 20.5).

Vomer setapinnis (Mitchill)
1968 – Two Atlantic moonfish (96-219 mm) were taken, one from the 10 fathom station on December 9 (salinity 33.2, temperature 16.3), and one from the 30 fathom station on June 10 (salinity 37.9, temperature 27.7).

Eucinostomus argenteus Baird and Girard
1969 – One spotfin mojarra (152 mm) was taken on February 26 from the 30 fathom station (salinity 16.6, temperature 14.1).

Cynoscion nothus (Holbrook)
1967 – Three specimens (225-235 mm) were taken, one from ten fathoms on January 21, the other two from the 40 fathom station on March 15 (salinity 21.5 - 36.2, temperature 14.4 - 19.0, respectively).

Equetus acuminatus (Bloch and Schneider)
1969 – Five cubbyu (130-164 mm) were taken, three on March 22

from the 30 fathom station (salinity 36.5, temperature 16.4), one on March 21 from the 30 fathom station (salinity 35.7, temperature 16.9), and one on April 29 from the 30 fathom station (salinity 19.8, temperature 37.4).

Larimus fasciatus Holbrook
1967 – A total of five banded drum (136-170 mm) were taken from the 10 fathom station, four on November 14 (salinity 35.4, temperature 19.5), and one on September 7 (salinity 33.4, temperature 31.6).

Menticirrhus americanus (Linnaeus)
1967 – Four southern kingfish (178–225 mm) were taken from the 10 fathom station. On January 21 two were taken (salinity 21.5, temperature 14.5), on September 7 one was caught (salinity 33.4, temperature 31.6), on August 3 one specimen was taken (salinity 36.8, temperature 25.2).

Pogonias cromis (Linnaeus)
1967 – One (612 mm) black drum was taken from the 6 fathom station on November 9 (salinity 32.4, temperature 17.0).
1969 – Two black drum (550-593 mm) were taken, one on January 22 from the 40 fathom station (salinity 37.4, temperature 16.9), and one on March 23 from the 10 fathom station (salinity 32.4, temperature 15.0).

Mullus auratus Jordan and Gilbert
1967 – One red goatfish was taken (66.3 mm) from the 50 fathom station on March 15 (salinity 33.8, temperature 20.0).

Archosargus probatocephalus (Walbaum)
1967 – One (546 mm) sheepshead was caught at 6 fathoms on January 29 (salinity 35.6, temperature 16.0).
1969 – One sheepshead (490 mm) was taken on January 14 from the 20 fathom station (salinity 31.5, temperature 16.7).

Lagodon rhomboides (Linnaeus)
1967 – Two specimens (155-174 mm) were taken, both on January 29 from the 20 fathom station (salinity 36.7, temperature 18.4).

Pagrus sedecim Ginsburg

1967 – Two specimens (264-370 mm) were taken at 50 fathoms on March 15 (salinity 33.8, temperature 20.0).

Chaetodipterus faber (Broussonet)
1967 – Five Atlantic spadefish (95-203 mm) were caught during this study, all from the 20 fathom station. On March 21 two specimens were taken (salinity 36.1, temperature 17.8), on February 2 two were taken (salinity 35.4, temperature 16.0), on October 27 one was taken (salinity 34.9, temperature 20.3).

Scomber colias Gmelin
1969 – One chub mackerel (229 mm) was taken on March 21 from the 40 fathom station (salinity 35.7, temperature 16.9).

Scomberomorus maculatus (Mitchill)
1967 – Two Spanish mackerel (285-288 mm) were taken on September 8 from the 10 fathom station (salinity 33.6, temperature 31.6).
1968 – Three Spanish mackerel (177-292 mm) were taken, two from the 10 fathom station on October 23 (salinity 35.7, temperature 24.8), and one from the 10 fathom station on November 20 (salinity 37.3, temperature 19.4).

Bollmannia communis (Ginsburg)
1967 – Four specimens (55-75 mm) were caught in two hauls, one on March 21 and one on August 29. Both hauls were during the night at the 20 fathom station (salinity 31.6 - 36.5, temperature 17.8 - 22.4, respectively).
1968 – One (90 mm) specimen was taken on June 18 from the 6 fathom station (salinity 28.8, temperature 29.5).

Neomerinthe pollux (Poey)
1967 – One (388 mm) spinycheek scorpionfish was taken from the 50 fathom station on March 21 (salinity 35.0, temperature 18.6).

Scorpaena calcarata Goode and Bean
1967 – One (87 mm) smoothheaded scorpionfish was taken on August 8 from the 50 fathom station (salinity 37.0, temperature 25.0).

Bellator militaris (Goode and Bean)
Two horned sea robins (87-112 mm) were taken, one from the 40 fath-

om station on November 15 (salinity 36.8, temperature 19.5); the other was caught at 50 fathoms on July 13 (salinity 37.2, temperature 18.9).

Peristedion gracile (Goode and Bean)
1967 – Five specimens (165-190 mm) were taken, three from the 50 fathom station on March 15 (salinity 33.8, temperature 20.0), and two from the 40 fathom station on March 15 (salinity 36.2, temperature 19.0).

Prionotus alatus Goode and Bean
1967 – Three spiny sea robins (110-113 mm) were taken from the 50 fathom station on March 15 (salinity 33.9, temperature 20.0).

Prionotus ophryas Jordan and Swain
1967 – One (160 mm) bandtail sea robin was taken from the Gulf on March 15 from the 50 fathom station (salinity 33.8, temperature 20.0).

Prionotus roseus Jordan and Evermann
1967 – One specimen (176 mm) was taken from the 30 fathom station on November 14 (salinity 37.0, temperature 22.0).

Prionotus scitulus Jordan and Gilbert
1967 – One (114 mm) leopard sea robin was taken from the 40 fathom station on August 8 (salinity 37.2, temperature 25.2).

Prionotus stearnsi Jordan and Swain
1967 – Four specimens were caught (79-105 mm), three on May 10 at the 30 fathom station (salinity 36.9, temperature 20.5). One was caught at the 20 fathom station on November 14 (salinity 36.8, temperature 20.3).
1968 – Four specimens (110-165 mm) were taken, two from the 20 fathom station on November 21 (salinity 37.3, temperature 16.4), one from the 50 fathom station on September 25 (salinity 37.3, temperature 18.9), and one from the 20 fathom station on December 10 (salinity 35.6, temperature 17.5).

Astroscopus y-graecum (Cuvier)
1968 – One (210 mm) Southern stargazer was taken at 6 fathoms on January 15 (salinity 26.1, temperature 15.1).

Kathetostoma albigutta (Bean)

1967 – Three specimens (113-154 mm) were taken during this study at the 40 fathom station in June, July, and August, one each on June 15 (salinity 34.6, temperature 20.3), on July 12 (salinity 37.0, temperature 25.1, and on August 8 (salinity 37.2, temperature 25.2).
1968 – Three lancer stargazers (106-127 mm) were taken from the 40 fathom station, one on July 25 (salinity 23.2, temperature 19.2), one on October 9 (salinity 29.8, temperature 25.5) and one on October 9 (salinity 28.2, temperature 19.2).

Bregmaceros atlanticus (Goode and Bean)
1967 – Two specimens (55 mm) were taken from the 50 fathom station on March 15 (salinity 33.8, temperature 20.0).

Brotula barbata (Bloch and Schneider)
1967 – Four specimens (216-315 mm) were taken. Two were from 50 fathom station, one on October 21 (salinity 37.2, temperature 24.0), the other one on July 25 (salinity 36.6, temperature 20.5). Two were taken from the 20 fathom station, one on August 29 (salinity 34.3, temperature 27.7), and one on January 29 (salinity 36.7, temperature 18.4).

Lepophidium graellsi (Poey)
1967 – Two (242-245 mm) blackedge cusk-eels were taken from the 30 fathom station on July 12 (salinity 37.0, temperature 25.1)

Ophidion welshi (Nichols and Breder)
1969 – Three crested cusk-eels (122-179 mm) were taken, one on May 15 from the 10 fathom station (salinity 33.2, temperature 20.2), one on February 24 from the 10 fathom station (salinity 25.7, temperature 14.9), and one on February 13 from the 6 fathom station (salinity 33.2, temperature 20.2).

Peprilus paru (Linnaeus)
1967 – One (150 mm) northern harvestfish was taken from the 20 fathom station on March 21 (salinity 36.1, temperature 17.8).
1968 – Two northern harvestfish (90-131 mm) were taken from the 6 fathom station, on January 15 (salinity 26.1, temperature 15.1), and on January 29 (salinity 28.5, temperature 14.8).

Sphyraena guachancho Cuvier
1967 – One (113 mm) specimen was taken from the 30 fathom station on November 14 (salinity 37.0, temperature 22.0).
1968 – Three specimens (210-344 mm) were taken, one from the 6 fathom station on March 27 (salinity 26.6, temperature 17.1),one from the 40 fathom station on March 26 (salinity 34.0, temperature 18.0), and one from the 6 fathom station on December 11 (salinity 34.9, temperature 14.4).

Mugil cephalus Linnaeus
1968 – One (355 mm) specimen was taken from the 20 fathom station on November 21 (salinity 37.3, temperature 16.4).

Ancylopsetta dilecta (Goode and Bean)
1967 – One (247 mm) three-eye flounder was secured from the 40 fathom station on March 15 (salinity 36.2, temperature 19.0).
1969 – One (163 mm) specimen was taken on May 29 from the 50 fathom station (salinity 19.9, temperature 20.5).

Ancylopsetta quadrocellata Gill
1967 - One (221 mm) ocellated flounder was taken in the Gulf on August 29 (salinity 36.5, temperature 22.4).

Citharichthys macrops Dresel
1967 – Four spotted whiffs (133-148 mm) were taken from the 10 fathom station on June 5 (salinity 35.1, temperature 25.0).

Citharichthys spilopterus Gunther
1967 – Three bay whiffs (128-152 mm) were taken, all from the 20 fathom station, two on July 26 (salinity 36.8, temperature 20.5), and one on August 29 (salinity 36.5, temperature 22.4).

Engyophrys sentus Ginsburg
1968 – Two specimens (73-87 mm) were taken, one from the 40 fathom station on November 21 (salinity 38.2, temperature 21.6), and one from the 20 fathom station on March 26 (salinity 24.6, temperature 17.0).

Etropus crossotus Jordan and Gilbert
1967 – Two specimens (80-88 mm) were taken, one at 40 fathoms on May 24 (salinity 36.7, temperature 18.8), the other on March 15 (sal-

inity 36.2, temperature 19.0).

Paralichthys lethostigma Jordan and Gilbert
1967 – Five southern flounders (270-390 mm) were taken. Four were from the 20 fathom station, on March 21 (salinity 36.1, temperature 17.8), on May 25 (salinity 36.7, temperature 20.8), on June 28 (salinity 36.6, temperature 20.3), on August 29 (salinity 36.5, temperature 22.4). From the 50 fathom station one was taken on May 21 (salinity 39.4, temperature 20.5).
1969 – Two southern flounders (250-276 mm) were taken on February 13 from the 6 fathom station (salinity 27.4, temperature 13.3).

Paralichthys squamilentus Jordan and Gilbert
1967 – Two broad flounders (216-265 mm) were taken from the 50 fathom station, one on March 15 (salinity 33.8, temperature 20.0), the other one on July 25 (salinity 36.6, temperature 20.5).
1969 – Three broad flounders (200-267 mm) were taken, one on January 22 from the 40 fathom station (salinity 37.4, temperature 16.9), one on January 23 from the 30 fathom station (salinity 33.8, temperature 14.4), and one on April 29 from the 30 fathom station (salinity 19.8, temperature 37.4).

Syacium gunteri Ginsburg
Two of these flounders (216-265 mm) were taken from the 50 fathom station, one on March 15 (salinity 33.8, temperature 20.0), the other one on July 25 (salinity 36.6, temperature 20.5).

Syacium papillosum (Linnaeus)
1968 – Two of these flounders (114-128 mm) were taken from the 40 fathom station on November 21 (salinity 31.5, temperature 20.7).

Gymnachirus texae (Gunter)
1967 – Five specimens (72-105 mm) were taken, two from the 10 fathom station on July 7 (salinity 34.2, temperature 23.3). On August 3 from the 10 fathom station two were taken (salinity 36.8, temperature 25.2). One was taken on May 24 from the 40 fathom station (salinity was 36.4, temperature 22.0).

Gymnachirus melas (Nichols)
1968 – One (153 mm) specimen was taken from the 40 fathom station

on March 26 (salinity 34.0, temperature 18.0).

Symphurus diomedianus (Goode and Bean)
1967 – Two spottedfin tonguefish (150-151 mm) were taken, one on March 15 from the 50 fathom station (salinity 33.8, temperature 20.0), and the other on January 29 from the 20 fathom station (salinity 36.7, temperature 18.4).

Symphurus plagiusa (Linnaeus)
1967 – One (156 mm) blackcheek tonguefish was taken on August 9 at the 40 fathom station (salinity 36.8, temperature 22.3).

Echeneis naucrates Linnaeus
1967 – One (383 mm) sharksucker was taken from the 30 fathom station on March 15 (salinity 36.2, temperature 20.0).

Alutera scripta (Osbeck)
1967 – Five scrawled filefish (85-97 mm) were taken. Three were from the 50 fathom station, on August 9 (salinity 35.6, temperature 25.0), on October 21 (salinity 37.2, temperature 24.0), on July 12 (salinity 37.2, temperature 18.9); from the 20 fathom station on August 29 one was taken (salinity 34.5, temperature 27.7); on March 7 from the 10 fathom station one specimen was secured (salinity 36.8, temperature 20.4).

Balistes capriscus Gmelin
1967 – Two gray triggerfish (133-153 mm) were taken. One came from the 200 fathom station on November 14 (salinity 36.8, temperature 20.3). The other was taken from the 30 fathom station on March 15 (salinity 36.2, temperature 20.0).

Monocanthus hispidus (Linnaeus)
1967 – One (133 mm) planehead filefish was taken at the 30 fathom station on February 22 (salinity 35.6, temperature 16.4).
1969 – Four planehead filefish (111-134 mm) were taken, two on January 14 from the 30 fathom station (salinity 340, temperature 15.5), one on April 29 from the 30 fathom station (salinity 19.8, temperature 37.4), and one on March 22 from the 30 fathom station (salinity 36.5, temperature 16.4).

Lagocephalus laevigatus (Linnaeus)
1969 – Two smooth puffers (91-146 mm) were taken, one on January 22 from the 40 fathom station (salinity 37.4, temperature 16.9), one on April 29 from the 30 fathom station (salinity 19.8, temperature 37.4).

Chilomycterus schoepfi (Walbaum)
1969 – Two striped burrfish (120-140 mm) were taken, one on May 15 from the 10 fathom station (salinity 33.2, temperature 20.2), one on January 14 from the 6 fathom station (salinity 33.2, temperature 10.8).

Antennarius radiosus Garman
1969 – Five singlespot frogfish (42-91 mm) were taken, two on May 15 from the 10 fathom station (salinity 33.2, temperature 20.2), one on April 30 from the 40 fathom station (salinity 37.4, temperature 19.5), one on May 26 from the 20 fathom station (salinity 21.6, temperature 18.4), and one on May 29 from the 20 fathom station (salinity 35.7, temperature 19.9).

Ogocephalus parvus Longley and Hildebrand
1967 – One (68 mm) roughback batfish was taken from the 40 fathom station on March 15 (salinity 36.2, temperature 19.0).

The writer wishes to acknowledge the help and suggestions of Dr. Gordon Gunter in preparing this paper.

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The Occurrence of Lymphocystis in *Micropogon undulatus* and *Cynoscion arenarius* from Mississippi Estuaries

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The occurrence of lymphocystis in *Micropogon undulatus* and *Cynoscion arenarius* from Mississippi estauries [1]

by

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ABSTRACT

Lymphocystis was observed in Atlantic croakers (*Micropogon undulatus*) and sand seatrouts (*Cynoscion arenarius*) collected from brackish waters of the Mississippi Gulf Coast. This is the first report of lymphocystis in fishes of the Gulf of Mexico and adds one family and two species to host records.

Microscopic examination of the tumors revealed several histologic differences in the lesions of the two species. Mature tumor cells in the croakers were larger than those in the sand seatrout. In the croakers, these cells were closely packed and their hyaline capsules were usually confluent. In the sand seatrouts, the tumor cells were rarely confluent and were usually widely separated either by interstitial connective tissue or by an amorphous, hyaline matrix that filled the intercellular spaces. A preliminary description of the histology of the neoplasm was included.

Ecological factors of the sampling stations where fishes infected with lymphocystis occurred were compared with stations where lymphocystis was not encountered. The pollution load was much greater in estuarine systems where lymphocystis was encountered. The chemical and physical differences observed at these stations were discussed.

INTRODUCTION

Since the first published account (Lowe 1874) of lymphocystis in fishes, the literature concerning this disease has become extensive. The

[1]This study was conducted in cooperation with the Department of the Interior, Bureau of Commercial Fisheries, under Public Law 88-309, Projects 2-24-R and 2-42-R.

gross and microscopic morphology of the tumor, as well as its viral etiology, are now well known. Since several recent reviews (Nigrelli and Smith 1939, Weissenberg 1954, Nigrelli and Ruggeri 1965, Sinderman 1966) of the literature are available, it is not necessary to discuss the history of lymphocystis here. In their review, Nigrelli and Ruggieri (1965) included an annotated bibliography of papers on lymphocystis. They also provided, in tabular form, a list of all host species of the virus. This list comprises 49 species of 20 families in 5 orders of fishes.

In March 1966, in conjunction with the Cooperative Gulf of Mexico Estuarine Inventory and Study Project, we began extensive sampling of the fauna in Mississippi Sound and adjacent waters. This study area included four estuarine systems which are, from east to west, *vid.* Fig. 1.: Pascagoula River, Biloxi Bay, St. Louis Bay and Pearl River. In a sample that was taken on January 13, 1967, we found one fish that exhibited tumorous lesions on its body and fins. We tentatively diagnosed the disease as lymphocystis and subsequently searched for diseased fishes in all of our trawl samples.

Little information concerning the environment in which lymphocystis infected fishes are found is available. Therefore, we have given special attention to several physical characteristics of our sampling stations throughout the entire period of sampling. These findings and our observations on the histology of the lymphocystis lesions in the Atlantic croaker *(Micropogon undulatus)* and the sand seatrout (*Cynoscion arenarius)* form the basis of this report.

MATERIAL AND METHODS

At least one trawl sample was scheduled for collection at monthly intervals at each of 35 of the 50 estuarine stations located in Mississippi Sound and adjacent waters of the Mississippi Gulf Coast, *vid.* Fig. 1. All stations were established between March 1966 and January 1967. Consequently, at least two years of sampling was scheduled for all stations. Trawl samples were scheduled for collection every other week at stations 13, 32, 37, 33, 34, 36, 31 and 35. Two samples (one daytime and one nighttime) were scheduled for collection at monthly intervals at each of 6 off-shore stations located at ten fathom contour intervals between the 5 and 50 fathom curves in the Gulf of Mexico.

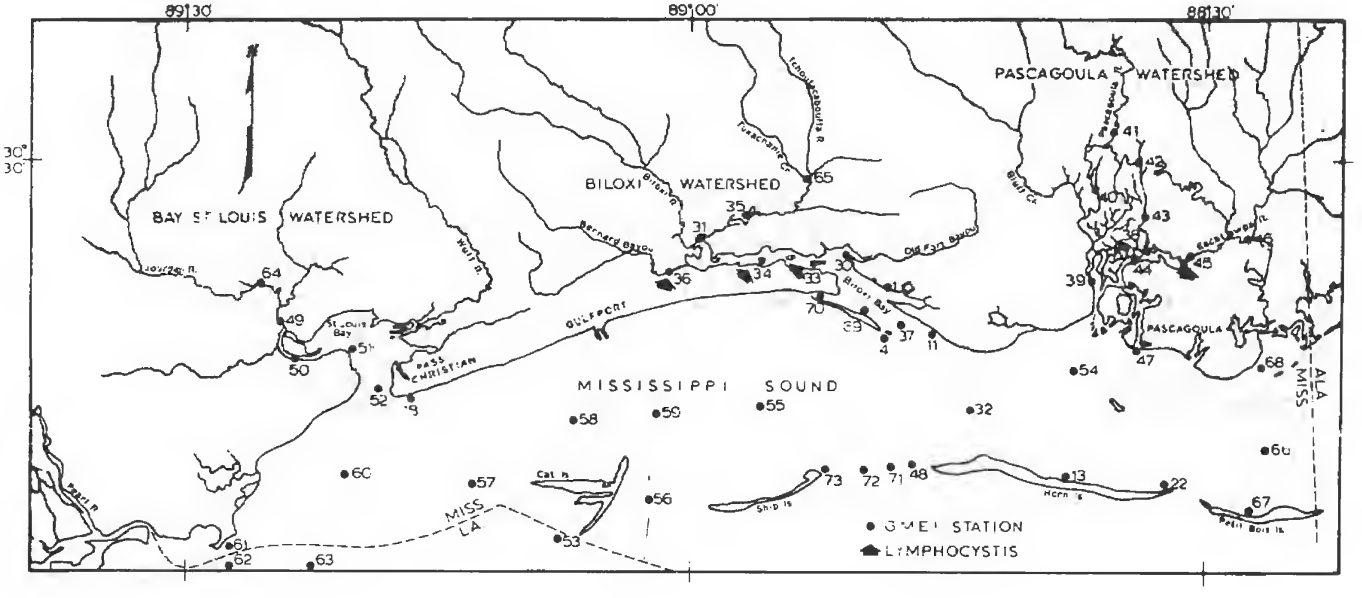


Figure 1. Mississippi estuarine study area showing location of GMEI permanent station.

Figure 2. Atlantic croaker (*Micropogon undulatus*) (A) and Sand seatrout (*Cynoscion arenarius*) (B) showing extensive lymphocystis lesions.

Figure 3. Caudal region of B, Figure 2 showing large mass and numerous solitary tumors.

vary in size and shape. Tumor cells in the croakers (Figs. 4 and 5) are irregular to ovoid in shape; in the sand seatrouts (Figs. 6 and 7) they are circular to ovoid. In the croakers, these cells measure up to 163 x 350 u in their short and long diameters respectively; in the sand seatrouts, they measure up to 150 x 188 u. Each cell is surrounded by a distinct hyaline capsule that, in the large cells, measures about 2.6 u in thickness (Figs. 4 through 8).

Each small differentiating tumor cell contains a single, centrally located nucleus embedded in a large amount of granular cytoplasm. A network of chromatin-like inclusion bodies is present in the cytoplasm of the larger differentiating tumor cells. These inclusion bodies are confined to the perinuclear region of the cell.

A large, eccentrically located nucleus is present in each mature tumor cell (Figs. 5 and 8). These cells also contain large amounts of granular cytoplasm. In each of the completely differentiated tumor cells, the number of inclusion bodies is markedly increased and they form an elaborate network at the cell periphery (Figs. 5, 6 and 8).

Normal tissue is mainly confined to regions of the tumor that contain small differentiating cells. This tissue surrounds each young tumor cell and is composed of the usual dermal cellular and connective tissue elements. Numerous capillaries are present. Normal tissue is infrequently encountered surrounding the mature tumor cells (Fig. 9). Hence, the hyaline capsules of these cells in *Micropogon undulatus* are either confluent or separated from each other only by thin strands of connective tissue (Figs. 5 and 8). However, the tumor cells in *Cynoscion arenarius* are widely separated either by connective tissue or an amorphous, hyaline matrix into which the hyaline capsules blend (Figs. 6 and 7) although the outer boundaries of the capsules remain discernible.

Physical characteristics of the environment: The specimens observed in this study were collected from eight of the trawl samples taken at estuarine stations 33, 34, 36 and 45 in the winter months between 13 January 1967 and 20 February 1969.

Ten specimens were obtained at three adjacent stations (Fig. 1) located in the Biloxi Back Bay area. Eight of these were collected at: Station 36 (30^0 27′ 24″ N, 88^0 56′ 24″ W) in Bayou Bernard. Two

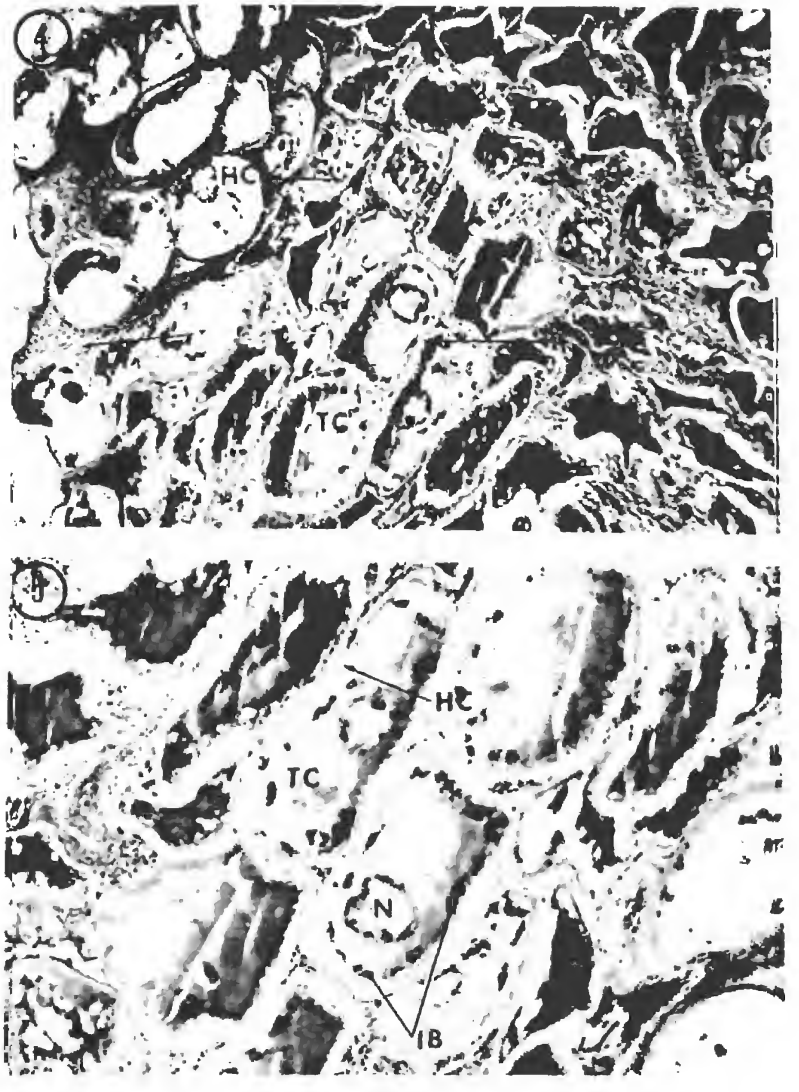


Figure 4. A section through a lymphocystis tumor from *Micropogon undulatus*. Mature tumor cells (TC) are shown in the left side of the photomicrograph and young tumor cells in the right side. Note the hyaline capsule (HC) around each tumor cell. (Arrows) - normal tissue. Hematoxylin-Eosin. 90 X.

Figure 5. A higher power view of a portion of the preceding figure showing the network of inclusion bodies (IB) at the cell periphery. (N) - nucleus; (HC) - hyaline capsule. Hematoxylin-Eosin. 160 X.

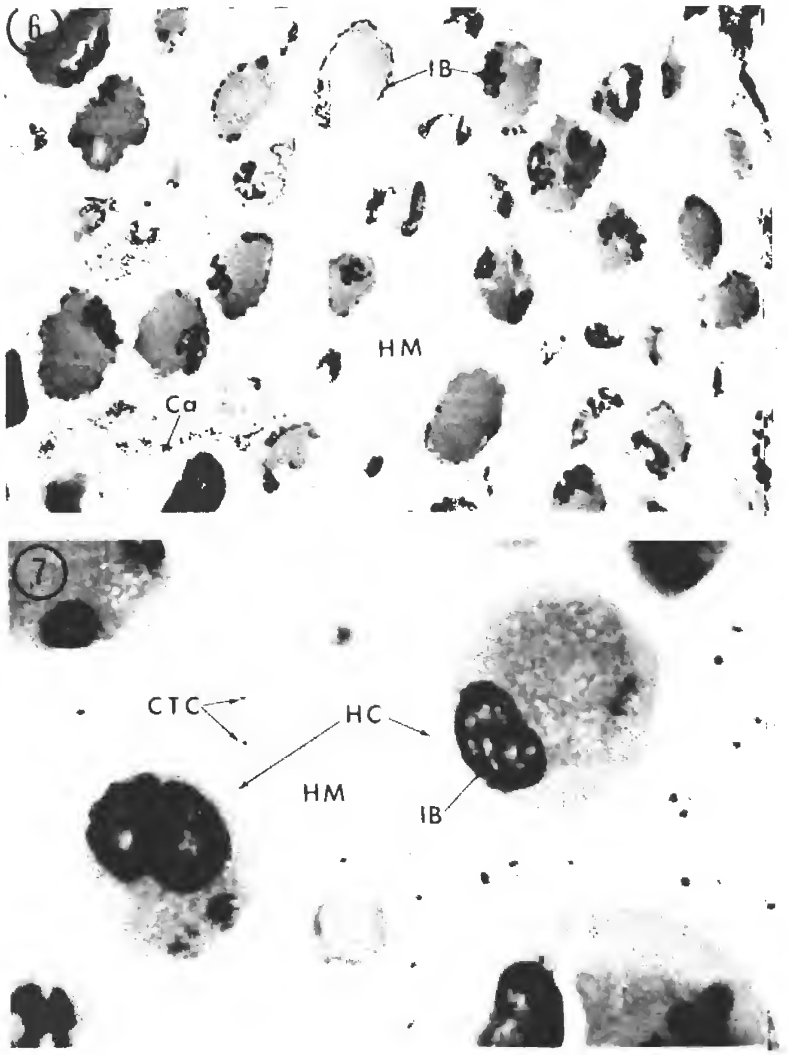
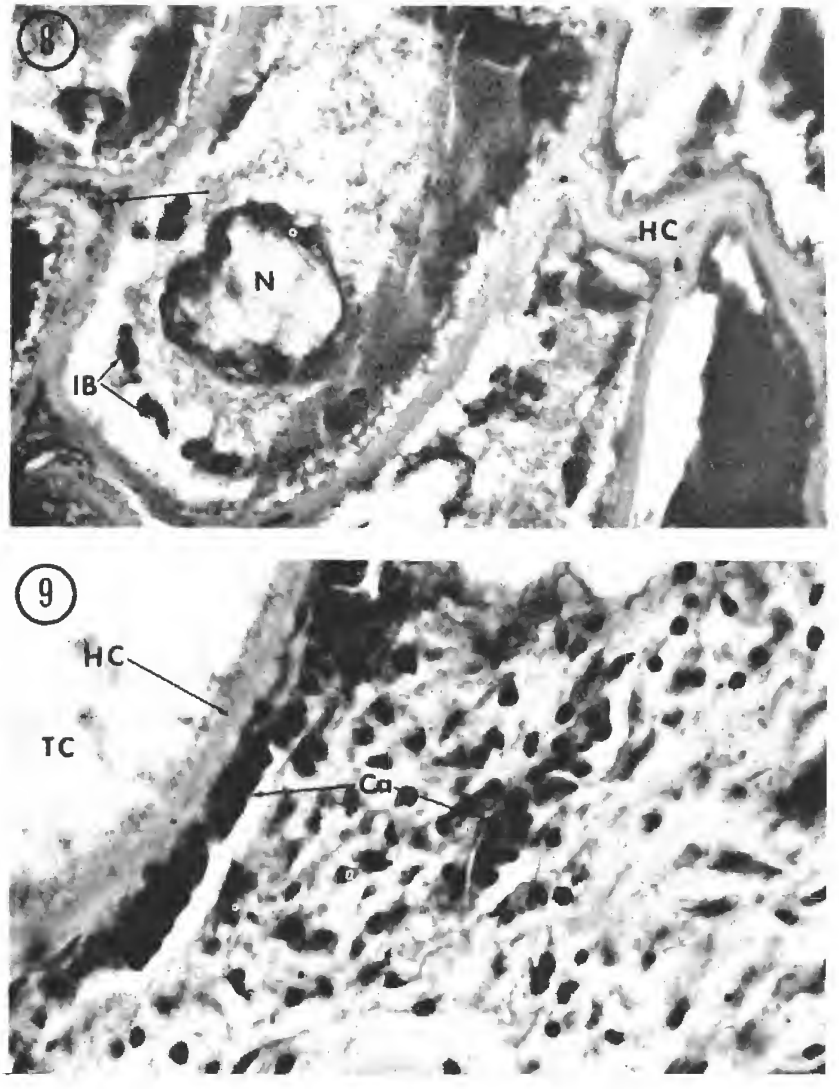


Figure 6. A section through a lymphocystis tumor from *Cynoscion arenarius.* Note that the tumor cells are rounded and widely separated from one another by a hyaline matrix (HM). Compare with Figure 4. (Ca)-capillary; (IB)-inclusion bodies. Hematoxylin-Eosin. 109 X.

Figure 7. A section through the hyaline matrix in the tumor from *Cynoscion arenarius.* Note the hyaline capsule (HC) and the connective tissue cells (CTC). (HM)-hyaline matrix; (IB)-inclusion bodies. Hermatoxylin-Eosin. 492X.



Section 8. Section through mature lymphocystic tumor cells from *Micropogon undulatus*. Note the large nucleus (N) and network of inclusion bodies (IB). Note also that the hyaline capsules (HC) of adjacent tumor cells are confluent. (Arrow) connective tissue. Hematoxylin-Eosin. 400X.

Figure 9. A view of intercellular connective tissue and the edge of a mature tumor cell (TC) from *Micropogon undulatus*. Note capillaries (CA) filled with erythrocytes. (HC)-hyaline capsule. Hematoxylin-Eosin. 896 X.

TABLE 1. - Occurrence of lymphocystis in fishes of the Mississippi estuaries and associated data for each collection.

Date	Sta.	No. Caught	Total length mm Min	Max	W/ly*	Water Depth Feet	Bottom Water Temp C°	Sal ppt	DO ppm	pH	Phosphate, uga/1 Ortho	Total	Nitrate ugs/1
						Micropogon undulatus							
1-13-67	36	667	55	280	220	12	11.1	01.7	----	----	-----	-----	-----
1-26-67	36	70	48	185	147	10	17.0	06.1	5.2	5.0	-----	-----	-----
2-9-67	36	51	136	277	231	11	11.2	02.2	8.8	5.0	-----	-----	-----
2-22-67	45	39	35	226	201	18	11.2	27.2	8.9	7.0	-----	-----	-----
					224								
2-23-67	36	29	23	216	159	10	14.0	02.2	7.8	6.8	-----	-----	-----
2-23-67	34	73	18	174	157	15	13.9	05.6	6.8	7.9	-----	-----	-----
11-27-68	33	3	127	144	144	12	16.0	24.4	12.7	7.9	.60	2.00	.31
2-20-69	36	122	146	225	146	10	11.9	12.2	8.5	6.4	2.00	4.50	2.70
						Cynoscion arenarius							
11-13-68	36	39	49	172	95	9	14.0	13.3	-----	7.2	3.00	9.75	.29
					172								
12-10-68	36	2	81	181	181	10	15	6.7	5.4	6.8	3.00	6.00	6.23

*/ Specimens with lymphocystis

TABLE 2 - Summary of Atlantic croakers and sand seatrouts caught by trawl at stations 33, 34, 36, 45 and 50, April 1966 through March 1969.
Figures in ly. column show the number with lymphocystis.

		Micropogon undulatus			Cynoscion arenarius			TOTALS		
Sta.	No. Smpls.	No. Caught	Catch per haul	ly.	No. Caught	Catch per haul	ly.	No. Catch	Catch per haul	ly.
45	22	214	9.7	2	3	0.1	0	217	9.8	2
33	65	5,108	78.6	1	1,603	24.7	0	6,711	103.3	1
34	65	4,210	64.8	1	2,018	31.0	0	6,288	95.9	1
36	65	7,963	122.5	5	5,903	90.8	3	13,866	213.3	8
Sub Tot.	217	17,425	80.3	9	9,527	43.9	3	27,022	124.2	12
50	21	3,040	144.8	0	2,626	125.0	0	5,666	269.8	0
TOT.	238	20,465	86.0	9	12,153	56.7	3	32,688	137.3	12

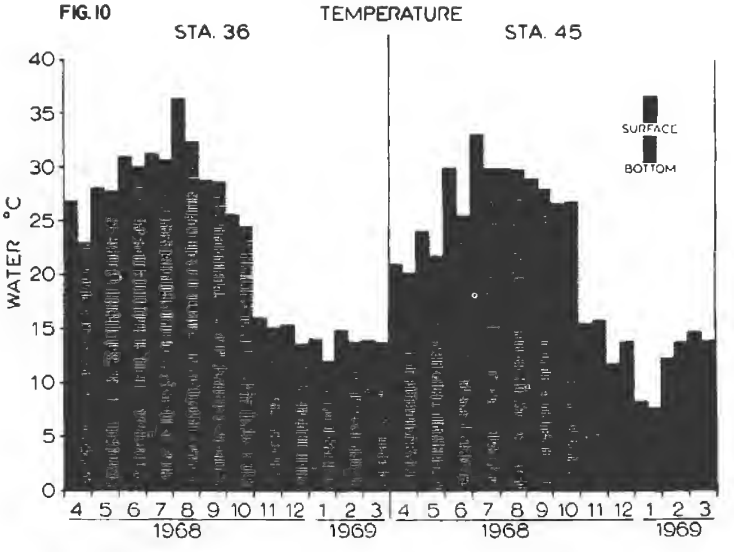
infected specimens were found among the 9,318 Atlantic croakers collected at stations 34 (30° 24' 53" N, 88° 55' 47" W) and 33 (30° 24' 47" N, 88° 52' 33" W). These stations are located in Biloxi Back Bay 6 (9.7 kilometers) and 9 (14.5 kilometers) statute miles respectively, toward the open bay from station 36. These stations generally yielded a large number of numerous estuarine fishes and invertebrates during the entire sampling program. All of the infected sand seatrouts were found at station 36.

Two infected croakers were collected at station 45 (30° 25' 07" N, 88° 13' 17" W) in the Escatawpa River, 2.7 statute miles (4.3 kilometers) above its confluence with the Pascagoula River. Very few fishes and invertebrates were caught at this station.

The pertinent biological and physical data collected with these samples are summarized in Table 1. The lowest and highest bottom water temperatures recorded for these samples were 9.5° and 17.0° C. The minimum and maximum salinity concentrations recorded when infected specimens were found were 1.1 ppt and 27.0 ppt.

Numbers of croakers and sand seatrouts collected at these stations during the entire sampling period (March 1966 to March 1969) are given in Table 2. The numbers of these species caught in the St. Louis Bay system at station 50, where no lymphocystis was observed, are included for comparisons. The catch per haul at station 50 was 21% greater than at station 36 and 96% greater than at station 45.

Lymphocystis infected fishes were not encountered in the other two estuarine systems (St. Louis Bay and Pearl River) nor were any observed among the thousands of fishes, including croakers and sand seatrouts, collected between the above mentioned estuarine stations and the fifty fathom curve station in the Gulf of Mexico. Therefore, a comparison of the physical factors at stations 36 and 45 with those of station 50 (30° 20' 06" N., 89° 22' 25" W.), in the St. Louis Bay system is indicated. Each of the stations is located ten to twelve miles (19.3 kilometers) from the mainland coast line in the estuarine reach of a stream. The data for stations 36 and 45 during the period of April 1968 through March 1969 are shown in Figures 10 through 16. Data derived from the two or three samples collected every month at station 36 are averaged. All data for stations 45 and 50 are based on one sample



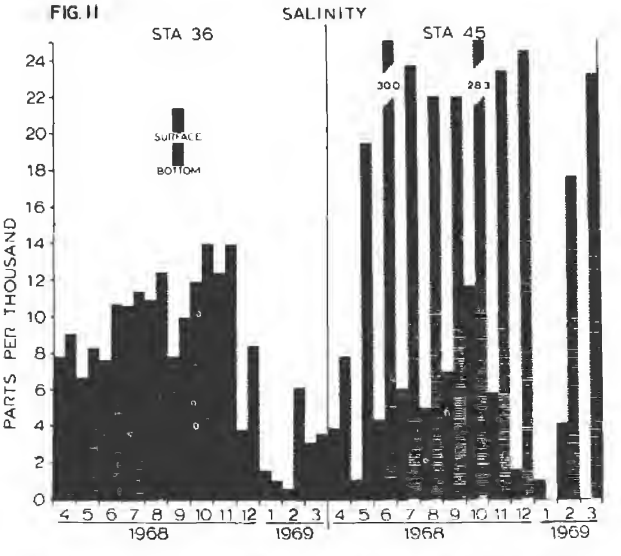
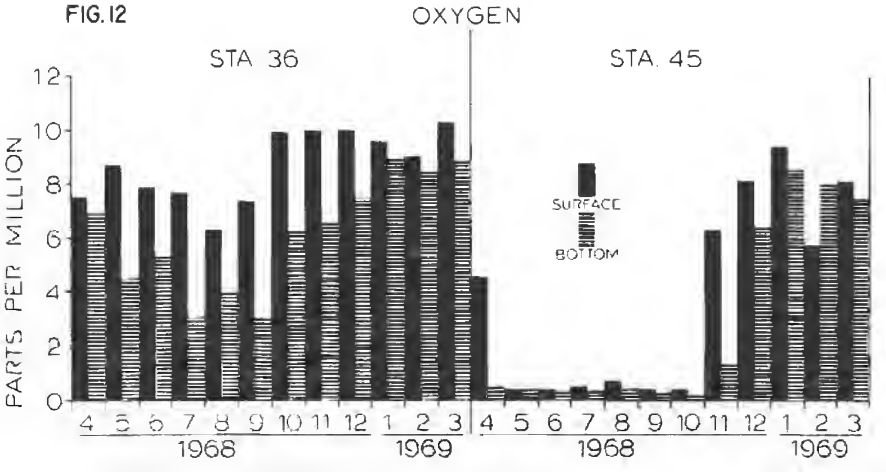


Figure 10. Surface and bottom temperatures at station 36 and 45, May 1968 through March 1969. Data for station 36 are averages of 2 or 3 samples collected during each month. One sample was collected each month at station 45.

Figure 11. Surface and bottom salinities at stations 36 and 45, May 1968 through March 1969. Data for station 36 are averages of 2 or 3 samples collected during each month. One sample was collected each month at station 45.



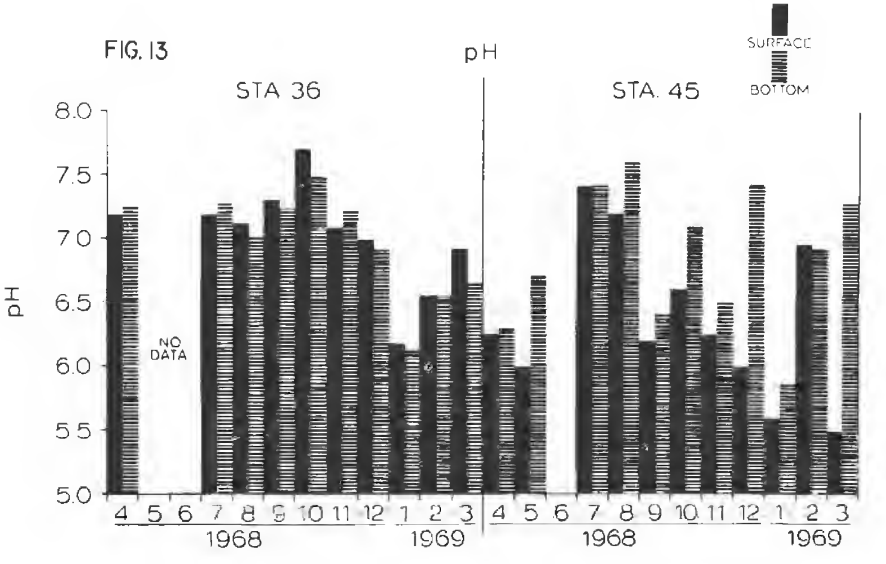
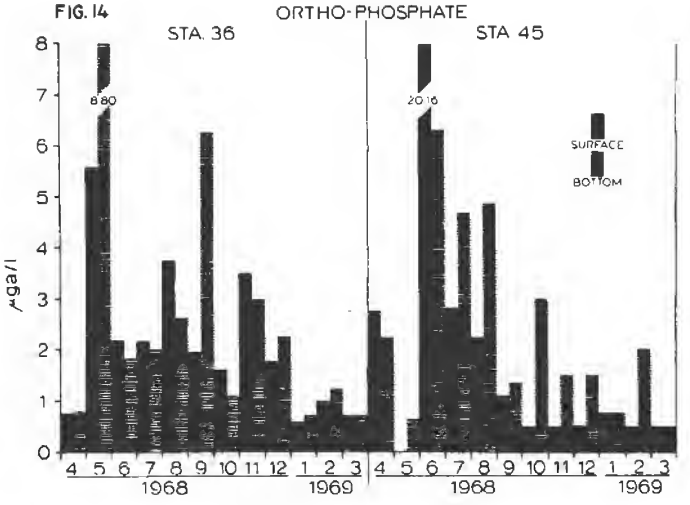


Figure 12. Surface and bottom dissolved oxygen concentrations at stations 36 and 45, May 1968 through March 1969. Data for station 36 are averages of 2 or 3 samples collected each month. One sample was collected each month at station 45.

Figure 13. Surface and bottom pH values at stations 36 and 45, May 1968 through March 1969. Data for station 36 are averages of 2 or 3 samples collected during each month. One sample was collected each month at station 45.



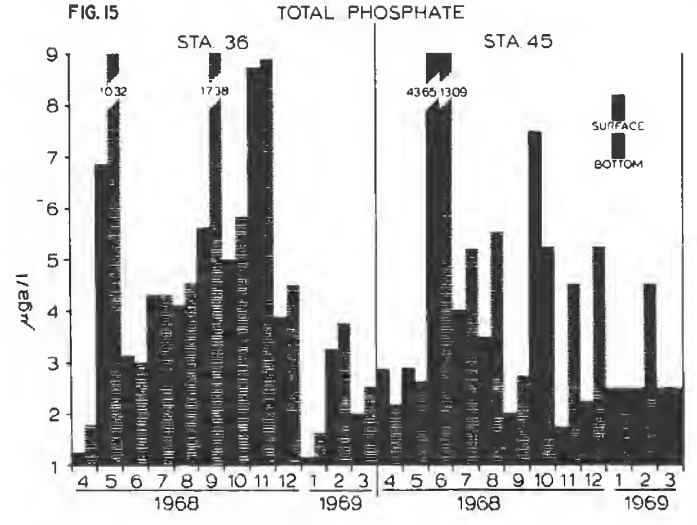


Figure 14. Surface and bottom orthophosphate concentrations at stations 36 and 45, May 1968 through March 1969. Data for station 36 are averages of 2 or 3 samples collected during each month. One sample was collected each month at station 45.

Figure 15. Surface and bottom total phosphate concentrations at stations 36 and 45, May 1968 through March 1969. Data for station 36 are averages of 2 or 3 samples collected during each month. One sample was collected each month at station 45.

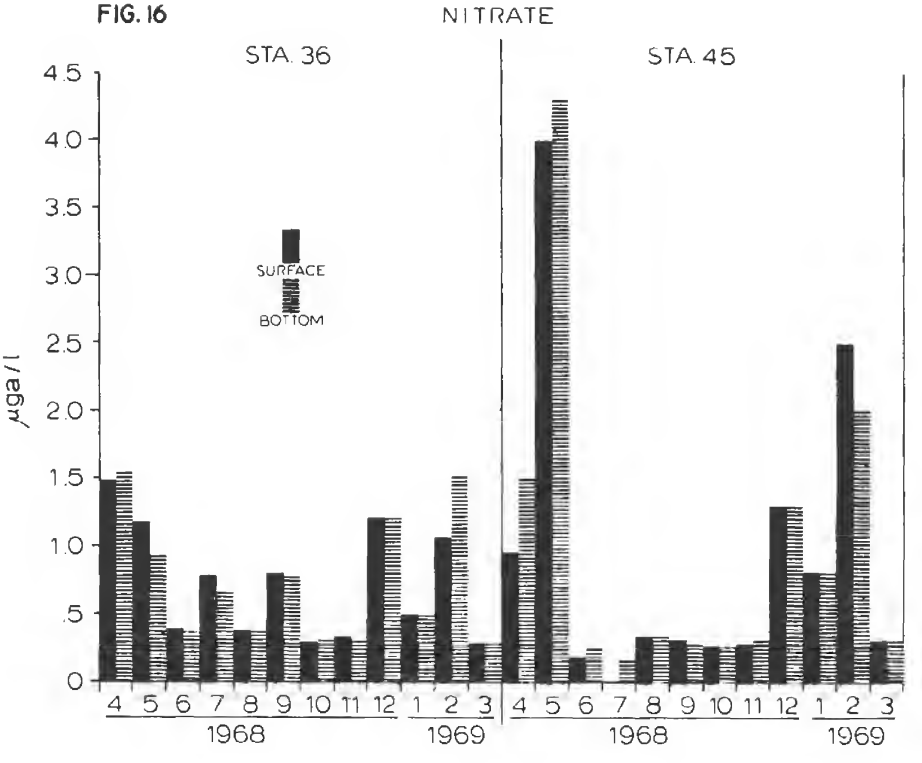


Figure 16. Surface and bottom nitrate concentrations at stations 36 and 45, May 1968 through March 1969. Data for station 36 are averages of 2 or 3 samples collected during each month. One sample was collected each month at station 45.

taken each month.

Water temperatures (Fig. 10, Table 3) at all three stations showed similar seasonal variations. All specimens with lymphocystis were collected after the water temperature had dropped below 15^0 C in the fall and before the spring warming trend. The temperature periodically exceeded 15^0 C during this period and the minimum temperature was about 8^0 C.

The salinity (Fig. 11, Table 3) at all three stations was generally lower during the winter months and fresh water was encountered in the entire water column at each station at least once during the study period. However, elevated bottom salinities were routinely encountered at station 45. This condition is apparently caused by the intrusion of salt water through the Pascagoula Ship Channel (controlling depth 38 ft.). The average surface salinity concentration (4.3 ppt) was lower at station 45 than at either station 36 (7.3 ppt) or 50 (8.2 ppt).

Dissolved oxygen concentrations (Fig. 12, Table 3) at all stations were well above the minimum requirement (5 ppm) for fishes during the winter months when lymphocystis was observed. However, anaerobic conditions persisted at station 45 during most of the remainder of the year. Bottom water oxygen concentrations below 5 ppm at station 36 occurred each month from May through October. Averages (Table 3) were below 5 ppm during July, August and September, 1968. At station 50, the lowest concentration recorded was 6.35 ppm in June 1968. Low oxygen concentration apparently accounts for the small number of specimens collected in the Escatawpa River.

The pH values (Fig. 13, Table 3) were generally a little lower at stations 45 and 36 than at station 50. Water in streams of Pascagoula, Biloxi Bay and St. Louis Bay watersheds usually has a pH value below 6 (Anon 1961-1966) before mixing with sea water in the estuary. The pH value of sea water is usually between 8 and 8.3.

Higher concentrations of ortho-phosphate were observed at stations 45 and 36 (Fig. 14) than at station 50 (Table 3).

Total phosphate concentrations (Fig. 15, Table 3) were extremely high during some months at stations 36 and 45. They exceed the maximum at station 50 several times during the year.

TABLE 3 Monthly records of temperature, salinity, dissolved oxygen, pH, and concentrations of ortho-phosphates, total phosphates and nitrates at stations 45, 36 and 50 for April 1968 through March 1969

	Temp C°		Sal ppt		Oxygen ppm		pH		PHOSPHATE Ortho µgat/l		PHOSPHATE Total µgat/l		NITRATE µgat/l	
STATION 45, Gear Type 5														
Month	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot.	Sur.	Bot	Sur	Bot.
4-68	21.0	20.2	3.9	7.8	4.60	0.50	6.25	6.32	2.88	2.15	2.87	2.20	0.95	1.50
5	23.9	21.8	1.1	19.4	0.41	0.40	5.97	6.71	0.00	0.66	2.90	2.64	4.00	4.30
6	29.9	25.5	4.4	30.0	0.40	0.31	---	---	20.16	6.30	43.65	13.09	0.19	0.25
7	33.2	29.9	6.1	23.9	0.48	0.35	7.42	7.43	2.92	4.68	4.07	5.18	0.00	0.17
8	29.9	29.8	5.0	22.0	0.70	0.46	7.20	7.60	2.25	4.87	3.50	5.55	0.34	0.34
9	29.9	28.0	7.0	22.0	0.40	0.00	6.20	6.40	1.12	1.35	2.00	2.75	0.37	0.29
10	26.6	26.8	11.7	28.3	0.40	0.20	6.60	7.10	0.50	3.00	5.25	10.50	0.27	0.26
11	15.5	15.8	5.8	23.3	6.30	1.84	6.23	6.50	0.50	1.50	1.72	4.50	0.28	0.31
12	11.9	13.9	1.7	24.4	8.19	6.38	5.98	7.43	0.50	1.50	1.50	5.75	1.67	1.35
1-69	8.4	8.1	1.1	0.0	9.40	8.55	5.58	5.86	0.75	0.75	2.50	2.50	0.82	0.82
2	12.4	13.7	4.2	17.7	5.75	8.05	6.96	6.88	0.50	2.00	2.50	4.50	2.50	2.00
3	14.6	13.9	0.0	23.3	8.20	7.45	5.48	7.28	0.50	0.50	2.50	2.50	0.31	0.31
MEAN	21.4	20.6	4.3	20.2	3.77	2.90	6.35	6.86	2.72	2.44	6.25	5.10	0.97	0.99
STATION 36.														
4-68	23.1	22.2	8.4	9.0	8.20	6.94	7.18	7.26	1.06	1.08	1.12	1.12	1.33	1.42
5	26.0	26.6	6.7	8.3	7.80	5.23	---	---	3.45	4.95	4.17	5.81	1.49	1.37
6	31.2	30.9	7.6	10.7	7.91	5.35	---	---	2.18	2.12	3.15	3.42	0.39	0.38
7	31.3	31.2	10.6	11.4	7.71	3.16	7.18	7.30	2.17	2.02	4.34	4.34	0.70	0.66
8	36.4	32.4	10.9	12.4	6.36	4.05	7.12	7.05	3.75	2.63	4.00	4.50	0.37	0.37
9	28.8	27.6	7.8	10.0	7.21	3.10	7.30	7.22	1.95	6.25	5.63	17.25	0.80	0.78
10	25.6	24.5	11.9	13.9	9.99	6.25	7.68	7.47	1.62	1.12	5.00	5.93	0.30	0.32
11	16.0	15.1	17.4	13.9	10.15	6.60	7.08	7.22	3.50	3.00	8.75	8.88	0.34	0.30
12	15.4	13.6	3.9	8.4	10.10	7.67	6.96	6.83	1.75	2.25	3.88	4.50	1.22	1.22
1-69	14.1	12.1	1.7	7.1	9.64	8.97	6.16	6.14	0.50	0.63	1.13	1.63	0.49	0.49
2	14.8	13.8	0.6	6.1	9.03	8.48	6.55	6.55	1.00	1.25	3.25	3.75	1.07	1.57
3	14.5	13.6	3.1	3.6	10.34	8.87	6.89	6.64	0.63	0.63	2.00	2.50	0.28	0.28
MEAN	23.1	22.0	7.3	9.2	8.78	6.35	7.03	6.97	1.95	2.28	3.91	5.32	0.72	0.72
STATION 50.														
4-68	22.4	21.7	8.1	8.9	6.98	6.71	6.35	6.50	1.72	1.50	1.88	1.56	1.42	1.42
5	27.7	27.4	7.2	8.3	7.10	6.63	7.60	7.40	1.56	1.56	1.64	1.64	1.53	1.86
6	31.0	31.1	6.7	7.8	7.96	6.35	8.85	8.20	1.40	3.85	2.10	4.50	.32	.38
7	31.5	30.0	7.2	13.3	7.71	6.65	7.85	7.45	.62	2.48	.90	3.00	.84	1.05
8	30.0	30.0	12.2	12.2	7.30	6.70	---	---	.75	.75	1.75	4.00	.34	.34
9	27.3	26.1	9.7	12.2	8.33	7.49	7.07	7.30	.50	1.00	1.50	3.75	.68	.68
10	27.1	26.9	14.4	16.6	7.71	6.59	7.40	7.50	.50	1.00	1.50	1.87	1.00	.48
11	14.2	14.2	12.2	17.8	10.00	9.90	7.10	7.70	.50	.50	2.00	2.00	.52	.31
12	11.0	10.0	8.9	11.4	11.80	12.80	7.17	7.35	1.00	1.00	2.50	2.00	.82	1.35
1-69	8.9	8.6	4.4	12.8	10.10	10.80	7.74	7.95	.75	.50	1.50	.75	.33	.33
2	16.8	15.8	3.3	9.0	10.60	10.15	6.80	6.55	.50	.50	3.00	3.00	.36	.33
3	11.0	11.8	3.9	12.8	8.80	7.80	7.71	6.90	.50	.50	3.00	3.00	.31	.31
MEAN	21.7	21.1	8.2	11.9	8.70	8.21	7.36	7.35	.87	1.27	1.82	2.47	0.71	0.74

Nitrate concentrations (Fig. 16, Table 3) were similar at all three stations. The averages of concentrations at station 45 were higher because 4.00 and 4.30 *u*ga/1 were recorded in May, 1968.

DISCUSSION

The results of this study confirm the diagnosis of lymphocystis in the Atlantic croaker (*Micropogon undulatus)* and the sand seatrout *(Cynoscion arenarius).* This finding adds one species from each of two genera and one[1] family (Sciaenidae) to the list of fishes that are known to be hosts of lymphocystis.

A single specimen of *Gunterichthys longipenis* "apparently infected with lymphocystis disease" (Dawson 1966) was collected in the Mississippi Sound near the east end of Ship Island in March 1963. However, this observation has not been verified by microscopic examination of the lesion (Dawson, personal communication).

Weissenberg (1945) showed that differences between fish groups are evident in the tumor cells of lymphocystis, especially in the development and configuration of the inclusion bodies. Nigrelli and Ruggieri (1965) stated that subtle differences between species exist but they have not been characterized. In addition to the variation in the maximum size of the mature tumor cells, we found a difference in the intercellular regions of the tumors of our two species. In the sand seatrout, but not in the Atlantic croaker, a hyaline matrix that is morphologically similar to the cell capsule is frequently present in these regions. Neither the origin nor the significance of this matrix was evident. Further structural and histochemical studies of the capsule and matrix are now in progress in our laboratories.

It is interesting that we have encountered only twelve lymphocystis-infected specimens among the thousands of fishes that were collected during the three year sampling period, especially since numerous young, infection-free specimens of several species (*i.e., Lepomis macrochirus, Pomoxis nigromaculatus, Ceratocanthus schoepfi* and others) that are known to be hosts of lymphocystis were present in the samples.

All the diseased fishes observed in this study were obtained during

[1]Two families if Otholithidae is a valid family.

the winter months of three successive years. This finding is in accord with those of other studies (Weissenberg 1945, Hansen 1951, Wolf 1962) which showed that low temperatures (12.5^0 C in Wolf's experiments) favor the outbreak and transmission of lymphocystis in a fish population. However, outbreaks of lymphocystis occur also in the summer months (Nigrelli and Smith, 1939; Witt, 1955). Indeed, in his study of white crappie from the Niangua Arm of the Lake of the Ozarks, Witt (1955) showed that the highest incidence of lymphocystis occurred in July. The occurrence of this disease in some species of of fishes during the summer and other species during winter is not understood. The influence that fluctuations in chemical factors (*i.e.*, oxygen concentration, salinity, pH, etc.) of the environment may have on the incidence and course of lymphocystis is unknown. In order to compare environmental conditions in estuaries, we must also note influences that result from conditions in their respective watersheds and the amount of sediments and pollution contributed by these areas.

Drainage areas of these systems vary markedly. They are as follows: Escatawpa River - 630 square miles (1827.5 square kilometers), Bayou Bernard - 75 square miles (194.2 square kilometers) and Jourdan River - 350 square miles (906.5 square kilometers). The average flow of these streams is approximately 2 feet ^{3}/second (.56 meters ^{3}/second) per square mile of drainage area but with considerable annual variation (Anon. 1961-1966).

Preliminary estimates of gross erosion and annual sediment yields (A.C. Burford, personal communication) indicate that erosion of the Escatawpa River watershed (1993 tons /sq. mi. annually) is greater than that of the Jourdan River watershed (1770 tons /sq. mi. annually). Conversely, the portion of sediment delivered by the Jourdan River (476 tons /sq. mi. annually) through the vicinity of our stations is greater than by the Escatawpa (372 tons /sq. mi. annually). The suspended sediment load in the Bayou Bernard watershed is unknown.

Robertson Lake, in the Escatawpa, and Big Lake at the mouth of Bayou Bernard, located immediately down stream from stations 45 and 36 respectively, collect some of the finer suspended sediment load of these streams by spreading and slowing the flow. Both are shallow areas with soft mud bottom and intertidal mud flats. No comparable condition exists between station 50 and St. Louis Bay.

The lower Escatawpa River and Bayou Bernard are grossly polluted but the Jourdan River is in a relatively pristine condition. Since most of the watershed of each of these streams is located in Jackson, Harrison and Hancock Counties, respectively, examination of the population densities of these counties gives some idea of the relative amount of pollution possible. The estimated 1968 population (Smith 1969) divided by the County area gives the following numbers of persons per square mile: Jackson County - 109.7, Harrison County, 277.4 and Hancock County - 36.7. The population in each county is concentrated along the coast.

Industrial pollution is varied and heavy in both Bayou Bernard and the lower Escatawpa River (Wakefield 1966, Panagiotou 1968). Slow tidal exchange increases the time of stay of pollutants in both streams. No significant industrial pollution exists in the Jourdan River.

No cure for lymphocystis is known (Wolf 1968). Although this disease currently may not be important in wild populations, both the increasing ecological stress (*i.e.*, pollution, and possibly other factors such as boat traffic) on estuarine populations and the mounting interest in mariculture emphasize the importance of determining the relationship between the disease and the physical conditions of the environment. This problem can be clarified only by long range investigations of environment where this disease occurs with some degree of regularity.

The fact that heretofore lymphocystis has not been diagnosed in fishes of the Mississippi Gulf Coast area suggests one of the following interpretations: Lymphocystis has only recently been introduced into the waters of the Mississippi Gulf Coast; the disease has been present indefinitely, but its incidence and course are suppressed by unknown factors; lymphocystis has been present indefinitely, but remained undetected because of the lack of systematic sampling of the fish population in the estuarine and river systems; fish under increasing environmental stress are more susceptible to lymphocystis virus. The observations of this study provide no information as to which of these interpretations is correct.

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